Abstract

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Summary:

This thesis examines the phenomenon of international collaboration in the field of aerospace technology to determine why such projects succeed or fail. Both firm- and state-level collaboration is discussed, though the primary emphasis is on government-led projects. Factors encouraging increased collaboration stem primarily from a desire to reduce risks, given the present environment of increasing costs coupled with shrinking budgets and certainty of returns. At the same time collaboration is inhibited by a fear that the fruits of the effort may not be distributed proportionally to each participant's investment. Thus this thesis uses an analytical approach based on Jonathan Tucker's "Partners and Rivals" (PAR) theory which accounts for such mixed motive situations.

The thesis discusses the national interests of the U.S., Japan, and South Korea relevant to both military and civil aerospace projects. It then introduces four case studies: the F-2 (formerly FS-X), the Korean Fighter Program, and the International Space Station all of which were collaborative and the Japanese H-2 rocket program which was not. Each of the cases is analyzed using the PAR model and compared to the theoretical predictions. Based on these results, the PAR model is modified with three new caveats.

Finally this modified PAR model is used to evaluate the proposed Theater Missile Defense program. While the theory is unable to predict whether the project will succeed or fail, it does provide a mechanism for gaining insight into the nature of the obstacles currently hindering collaboration as well as some possible approaches to resolving these issues.

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AEROSPACE COLLABORATION

Theories and Case Studies From the U.S.-Japan and U.S-Korean Experience:

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by

Stanley Dean Crow, Jr.

A thesis submitted in partial fulfillment

of the requirements for the degree of

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Introduction

Collaboration on projects of mutual interest between governments and corporations of different nations has become increasingly common in recent years, particularly in the realm of high-technology. Examples range from the international space station to the internationally-distributed production of commercial aircraft.[1] In some cases these undertakings succeed in achieving the objectives for which the participants entered into them, while in others one or both partners become dissatisfied and the projects end in failure.

This thesis will examine the issue of collaboration on international aerospace projects between the U.S. and Japan and the U.S. and Korea in order to determine why some efforts succeed while others fail. Because of the complexity of the topic, the discussion is divided into four main sections. The first section examines the issue in terms of costs and benefits to the actors involved -- private firms and nation-states. It begins with a discussion of the general environment in which today's collaborative ventures occur, describing those factors that lead corporations and states to seek partners as well as other factors inhibiting such collaboration. The section then concludes with the presentation of a theoretical model through which collaborative undertakings can be analyzed. The second section presents a more detailed discussion of the specific interests

[1]For more information on the trend towards international collaboration in high technology, see Denis Fred Simon and Soh, Chang-Rok, "U.S.-Korean Industrial and Technological Cooperation in the Context of Globalization and Regionalization," Joint U.S.-Korea Academic Studies, V6, 1996, pp. 9-50; Chikako Iguchi, "International Cooperation in Lunar and Space Development," Space Policy, Aug 92, pp. 256-268; and

of the state-level actors involved. This is necessary because the interests of nations, unlike those of firms which can be simply described as profit maximization, are diverse; each nation must determine its overall interests based on the sometimes competing demands of national defense and economic growth, both of which are impacted by aerospace technology. The third section is a series of four case studies of current collaborative projects which will be analyzed in relation to the preceding theories and interests. Finally the lessons learned from these case studies will be used to revise the theoretical model and apply the improved model to a proposed collaborative project -- the U.S.-Japan Theater Missile Defense System (TMD) -- in order to identify problem areas likely to be faced by policy makers.

The application of this research extends beyond TMD. The theories and lessons learned will be significant for any corporate or government collaborative venture in the area of high-technology. The field of aerospace has been selected for this thesis due to the author's familiarity with the subject matter and because it represents the most complicated case, in which the defense and industrial interests of nation-states and the technological and competitive interests of individual firms are all salient. Theodore Moran and David Mowry, writing on this topic, note that

> the aerospace industry provides a good setting to examine the costs and benefits of maintaining a liberal policy toward international collaboration versus those of shifting toward a neomercantilist alternative. The industry constitutes a leading sector for new technologies emerging along the frontiers of advanced research. It employs a skilled workforce and has many links to other sectors of the economy; it embodies elements of

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Denis Fred Simon, ed., The Emerging Technological Trajectory of the Pacific Rim, Armonk: M.E. Sharpe, Inc., 1995.

> oligopoly as well as competition; and it is vital for civilian and military needs.[2]

Thus transfer of the lessons and analytical processes from this thesis to other sectors of the economy should involve a reduction in complexity, as the salience of either state or firm interests recede.

One limitation of this study is its exclusive focus on collaborative efforts between two partners. The one case study that comes from a multilateral venture -- the international space station -- has been simplified by reducing the analytical scope to include only the bilateral U.S.-Japan aspects of the undertaking. Thus future studies that expanded this work to the examination of collaboration among three or more participants would also be valuable in further refining the analytical procedures and insights developed herein.

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[2]Theodore H. Moran and David C. Mowery, "Aerospace and National Security in an Era of Globalization," in Denis Fred Simon, ed., Techno-Security in an Age of Globalization: Perspectives from the Pacific Rim, (Armonk: M.E. Sharpe, Inc., 1997), p. 227.

Part I: General Interests and Collaboration Theory

Collaboration occurs when two or more parties combine resources to accomplish a task of mutual interest. Forming a team allows the participants to bring to bear more assets than either could (or perhaps is willing to) commit to a unilateral effort. Yet firms and states are inherently competitive, a nature that imposes limits on the unrestricted sharing of assets, particularly when the assets involved are critical to one's competitive edge -- or survival. Thus the first step in developing a theory of collaboration is to briefly outline the factors that promote and limit such ventures.

Factors Promoting Collaboration

Risk Management

The primary impetus for collaboration in aerospace is the need to manage risk. While in part driven by the realities of rising costs and reduced budgets (discussed below), the problem of risk is the real issue that prompts most decision makers to seek a partner and collaborate. As Ernst Haas writes, "International collaboration...is an attempt to reduce uncertainty when a multiplicity of values are at stake and the simplest strategy for reducing uncertainty -- autarky -- is not practicable."[3] For firms, the uncertainty of both the quantity and timing of returns in any venture that requires significant research and development makes it extremely difficult to justify either to shareholders or to outside sources of investment capital that such an undertaking is warranted:

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[3]Ernst B. Haas, "Why Collaborate? Issue Linkage and International Regimes," World Politics, Vol. 32, No. 3 (1980), p. 378.

> Higher development costs make corporate alliances attractive as a means to reduce the need to "bet the company" on each new generation of products.... [Thus one] motive for international collaboration in civil aerospace...has been the desire to have subcontractors assume a major risk-sharing role.[4]

For states, uncertainty of both the outcome of industrial policy and the likelihood that sophisticated new weaponry would actually be required for defense makes it difficult to justify the necessary resource allocations to those elements of government with budgetary authority. Writing from his experience with the NATO arms market, Ethan Kapstein cites this phenomenon in his description of defense collaboration policy:

> R&D in the defense area was expensive and highly risky; the chances that a given scientific investigation would translate into a weapon that was ultimately procured by the armed forces was slim....Accordingly, public officials and defense industry executives were seeking new ways to spread the financial and technical risks associated with the weapons acquisition process.[5]

One solution, therefore, is to find an international partner who perceives a similar need for the project and is willing to commit resources jointly, thereby reducing the degree of risk required by either party.

Cost Control

Building products which involve cutting-edge technologies has become increasingly expensive. As Kapstein notes, there is

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[4]Moran and Mowery, p. 233.

[5]Ethan B. Kapstein, "Arms Collaboration Policy," in Robert J. Art and Seyom Brown, eds, U.S. Foreign Policy: The Search for a New Role, (New York: MacMillan Publishing Co., 1993), p. 223.

> a growing problem in defense budgeting, namely, the costs associated with basic research. A modern weapons system, like the Advanced Tactical Fighter (ATF), could absorb hundreds of millions of dollars in "paper studies" before prototypes were even built....During the 1950s, the "up front" R&D costs associated with weapons acquisition constituted only 5 percent of the cost of the system; by the 1980s this had risen to more than 50 percent.[6]

This rising cost of advanced systems has made major projects ever more difficult to undertake. Aerospace has always been confined to the relatively advanced nations and firms. But recently, even the largest countries are finding some projects too expensive to complete autonomously, as evidenced by the U.S.' decision to cancel the Super Conducting Super Collider when it failed to attract sufficient interest from countries such as Japan. As Haas notes, "The need for collaboration arises from the recognition that the costs of national self-reliance are usually excessive."[7]

And yet collaboration does not eliminate all cost constraints. Because of the need to coordinate activities between two entities and the attendant expenses of translation, communication, and negotiation, the collaborative project always costs *more* in absolute terms than one performed entirely in-house by a single corporation or country. One estimate places the additional cost of collaboration at 1/3 of the entire project cost.[8] So a collaborative effort would cost 133% of the budget required for an autonomous one. This management overhead leads Kapstein to term collaboration a "'second best' solution" in terms of overall economic efficiency but one that is nevertheless sometimes the only

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[6]Kapstein, pp. 222-223.

[7]Haas, p. 357.

[8]Joan Johnson-Freese, Over the Pacific: Japanese Space Policy into the 21st Century, (Dubuque: Kendall/Hunt Publishing Co., 1993), p. 11.

feasible one due to political and budgetary constraints on the parties.[9] Total costs may be higher, but if the costs are divided equally between two partners, the amount that must be borne by each is only 67% of that of an independent effort.

Reduced Budgets

Further aggravating the cost problem is the advent of shrinking national budgets for defense procurement and civilian R&D. The following data from the U.S. National Science Foundation and the OECD show that after peaking in the late 1980s, the trend in both Japan and the U.S. is downward:

Table 1. R&D Spending by Year, U.S. and Japan[10]

Total spending on R&D as % of GDP		
	U.S.	Japan
1983-86 (ave)	2.80	2.80
1990	2.82	3.08
1993	2.72	2.93
Annual Growth Rate in Total R&D Spending (%)		
	U.S.	Japan
1990	3.2	8.3
1993	-.5	-2.4
Annual Growth in Private Sector R&D Spending (%)		
	U.S.	Japan
1990	6.6	10.0
1993	-0.8	-6.6

9Kapstein, p. 213.

10Sources: "Figures Confirm Global R&D Spending Trends," Nature, Vol. 376, 3 Aug 95, p. 379 and Leonard L. Lederman, "Science and Technology Policies and Priorities: A Comparative Analysis," Science, Vol. 237 (4 Sep 84), pp. 1125-1133.

Government-side factors contributing to this decline include the end of the Cold War and the attendant reduction in defense budgets as well as constraints from deficit reduction programs. For industry, recession is likely the greatest constraint as indicated by the third table in which the collapse of the Japanese "bubble" appears to have taken a heavy toll.

In South Korea, by contrast, R&D levels have been rising dramatically. In 1978, total expenditures on R&D were 0.64% of GDP, reflecting, as one observer notes, "the general lack of interest in R&D among Korean firms at the time and their tendency to ignore the potential value of long-term commitment to research."[11] But soon thereafter such interest began to rise, as indicated by the following table:

Table 2. Korean R&D Spending by Year[12]

Year	Total R&D Spending as % GDP
1984	1.19
1987	1.78
1990	1.91
1993	2.30

If Korea is able to abide by its ambitious Science & Technology Development Plan, R&D expenditures will rise to a phenomenal 5% of GDP by 2001.[13] But despite this increase in investment, Korea has yet to break into the ranks of the significant players in the realm of science and technology. According to the OECD's recent assessment of Korea's science and technology system, "Korea cannot yet be considered a major contributor to

[11]Simon & Soh, pp. 16-17.
[12]Source: Simon & Soh, p. 17.
[13]Seongjae Yu, "Korea's High-Technology Thrust," in Simon (1996), p. 91.

many fundamental areas of science and engineering research."[14] Therefore this lack of indigenous high-tech capability means Korea's increasing R&D investment does not free it from the need to collaborate.

Access to Technology, Markets, and Capital

These factors have been described as three traditional motives for international collaboration.[15] Yet unlike the general trends towards risk management, increased costs, and reduced budgets which affect nearly all firms and states to some degree, these are specific motivators that, while not uncommon, are specific to individual firms and states.

Access to technology can be an issue for both firms and states. Corporations require new process and product technologies to stay competitive and profitable. It is often most economical to acquire technologies from other companies if they already exist rather than attempt to develop them autonomously in-house. For nations, international collaboration can be a means to move up the technological ladder, particularly for those states which have active industrial policies. To gain access to technology, firms and states have traditionally offered two forms of quid pro quo: market access and access to capital.

The need for market access can arise either when a given market is difficult to penetrate due to government protectionism or cartel behavior, or when a firm simply lacks the time or resources to break into a new market on its own. In these cases a firm

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[14]OECD, Reviews of National Science & Technology Policy: Republic of Korea, 1996, p. 163.
[15]Simon & Soh, p. 12.

may seek an international partner to act as a springboard, taking advantage of the partner's established position to allow rapid introduction of new products to the target area. Market access is often negotiated in conjunction with offset agreements required by either the host government or the foreign partner. These agreements specify a certain percentage or value of work to be performed in the target area with the understanding that this will lead to the transfer of technology:

> Military offset agreements functioned as market-opening devices in a world with strong neomercantilist pressures on the aerospace sector....Offsets are now a mainstay of sales to foreign governments and firms of both military and civil aircraft and are important in sales to both industrial and industrializing nations. Because the military systems sold by the U.S. firms to foreign governments in particular have increased greatly in quality in the past two decades, offset agreements that involve foreign sourcing of components for these systems are likely to transfer increasingly sophisticated technologies.[16]

This practice of building multinational support to ensure market access has played a significant role in commercial aviation as well, with both Airbus Industrie and Boeing seeking suppliers in the U.S., Europe, and Asia in order to facilitate sales abroad. In the case of Airbus, for example, over 50% of all aircraft components are produced in the U.S.[17]

Access to capital can mean either cost sharing for joint undertakings as discussed above or, in the sense used in this paragraph, royalty payments for one-way transfers of technology. Though losing popularity somewhat recently (see next subsection) the cash-for-technology approach was the dominant form of international cooperation for many

[16]Moran and Mowry, p. 232.
[17]Moran and Mowry, p. 232.

decades. Though the content of the trade in each direction was different, exchanging financial assets for technological ones often satisfies needs of both partners. As Kapstein writes, "National solutions to the problem of acquiring costly, high-technology defense goods depend upon the availability of two key resources: technological and financial assets."[18] This type of collaboration allows both partners to satisfy these requirements.

Thus the factors promoting collaboration include both general trends towards risk management, cost control, and reduced budgets that are apparent throughout the international system and the desire for access to technology, markets, and capital that motivate specific firms and states. These represent one side of the equation that is balanced on the other by countervailing factors that inhibit collaborative activities.

Factors Inhibiting Collaboration

Fear of Unequal Returns

The greatest impediment to collaboration between both firms and states is the fear that one's contributions will disproportionately benefit the other party, eventually harming one's own interests. As Haas writes, "Collaboration becomes conflictual only when the parties begin to disagree on the distribution of benefits to be derived."[19] This effect is particularly pronounced in high technology fields such as aerospace, in which there is great concern that divulging know-how can enable today's partner to become tomorrow's successful competitor. This fear leads to demands for proportionality in collaborative undertakings.

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[18]Kapstein, p. 214.

Proportionality means the benefits received by each partner are commensurate to the risks assumed. For firms, this is often cited as a necessary condition for successful collaboration.[20] The importance of satisfactory returns has manifest itself in the recent trend in corporate alliances to require of prospective partners a technological quid pro quo for shared know-how in addition to the traditional demands of market access or royalty payments. This means that firms must have a minimum level of technical competency in order to be considered for collaborative ventures. As evidence of this trend, Simon cites several cases of bilateral ventures in which technology flowed in both directions: the FS-X (now designated F-2) between Lockheed and Mitsubishi, the Motorola-Toshiba agreement, the collaboration between National Semiconductor and Singapore Semiconductor to produce VLSI CMOS application-specific integrated circuits, and the effort between IBM and Taiwan's NDC to produce computer hardware and software.[21] And the trend toward technological exchange is evident outside such close alliances as well. Even in the realm of direct royalty payments for technology the U.S. has been a growing technology importer, shown by the fact that in 1982 the country paid $89 million for rights to Japanese technologies while by 1990 the value grew to $491 million.[22] This illustrates both the increased technological competence of Japanese firms and the

[19] Haas, p. 362.

[20] Simon and Soh, for example, list this as one of four criteria for success (p. 12); William A. Fischer cites a study of 14 NATO codevelopment projects and another of European cross-industry alliances in the information industry, both of which include this as a necessary condition for success ("Alternate Strategies For Managing Critical Technological Assets in the Multinational Firm," in Simon (1997), p. 81).

[21] Simon, "Globalization, Regionalization, and the Pacific Rim," in Simon (1996), p. 18.

[22] Simon, "Globalization," in Simon (1996), p. 11.

increased awareness of U.S. firms of the value of Japanese technologies. The effect of this increasing reciprocity in technology flows has been to help satisfy the requirement for proportionality, thereby lessening the fear of unequal returns in collaborative ventures.

Theoretical Model

Now that the general trends encouraging and inhibiting collaboration have been identified, it is time to introduce a theoretical framework for the analysis of specific ventures.

Two-Level Game: Firms and States

The first step in laying out the theoretical model for this analysis is to make explicit a distinction that heretofore has been used implicitly: that the interests of states differ from those of firms; while the two may in some cases be harmonized, in others they may be contradictory. Denis Simon describes the two-tiered nature of this issue in the introduction to his book on collaboration: "There is a major gap between private sector perspectives regarding transborder collaboration and strategic alliances and those within the public sector." He then argues that it is necessary to differentiate among three levels of analysis. The first being the "system level" which corresponds to the general trends in the international political economy described above. The other two levels are:

> The *nation-state* level -- where traditional notions of national security and domestic welfare still hold a great deal of weight, even as they are being challenged by both external and internal forces. . .

> The *firm* level -- where the drive for markets and enhanced mobility are leading companies to reject many of the limits artificially imposed by national boundaries.[23]

This necessitates using an analytical approach which perceives the system of international collaboration as comprising a two-level game, played simultaneously by actors at each level and according to their own motives. The final assessment of any given collaborative undertaking will therefore be a composite analysis that considers both national and corporate interests while accounting for the contradictory drives to manage risk and cost while at the same time retaining critical information.

'Partners and Rivals' Model

The analytical approach used for this study will be the "Partners and Rivals" (PAR) model developed by Jonathan Tucker.[24] His approach is to examine "mixed-motive situations ... in which the players pursue common interests at one level and competing interests at another."[25] In keeping with the factors described above that simultaneously encourage and discourage collaboration, Tucker sees that

> a fundamental characteristic of international collaboration in advanced technology is that the players have a mixture of common and conflicting interests: a mutual desire to combine their resources synergistically to increase the size of the "pie," yet divergent interests when deciding how the joint benefits from collaboration (such as gains in technological know-how) are divided between them.[26]

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[23]Simon, "Techno-Security in a Age of Globalization," in Simon (1997), p. 5.
[24]Jonathan B. Tucker, "Partners and Rivals: A Model of International Collaboration in Advanced Technology," International Organization, Vol. 45, No. 1 (Winter 1991), pp. 83-120.
[25]Tucker, p. 85.
[26]Tucker, p. 86.

In this mixed-motive situation, actors seek both absolute gains in capability and relative gains vis-a-vis their competitors. Collaborating tends to increase absolute gains for all actors but carries risks of relative losses, particularly for the leader. On the other hand independent action freezes relative positions, protecting the leader's position for the time being but is often unsatisfactory due to the aforementioned high costs and risk of autarky. There is no single point at which relative and absolute gains will be optimized for all actors. Rather, there is a range of policy options that include varying degrees of autonomy and collaboration. This analytical framework borrows from Robert Gilpin's discernment of "indifference curves" in state behavior that describe sets of equally valued results sought by states using a "satisficing" strategy.[27]

The PAR model assumes first that in any collaborative scenario, there will be a certain degree of disparity in aggregate capabilities between the participants. In calculating whether and how to proceed, each player pursues two types of payoffs from collaboration: a short-term welfare payoff and a longer-tern positional payoff. The welfare payoff is the short-term benefit to both players in terms of added profits, risk-sharing, economies of scale, and larger markets. The positional payoff refers to each player's net gain or loss in relative capabilities. Without special procedures to control the flow of technology, Tucker sees a natural tendency for the weaker partner to realize a net positional gain over time as know-how flows to it. Thus the motives for collaboration will be based on the following evaluations:

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[27]Robert Gilpin, War and Change in World Politics, (Cambridge: Cambridge University Press, 1981), p. 20.

For the weaker partner: net payoff = welfare payoff + positional payoff

For the stronger partner: net payoff = welfare payoff - positional payoff

Thus the weaker participant always has an incentive to participate in a collaborative undertaking; the net payoff is always positive. But the stronger partner must weigh the welfare benefit against the positional loss in determining its desire to participate. Each of these payoffs varies in proportion to the ratio of capabilities between the two partners. The impact of welfare and positional payoffs on net payoff for the stronger partner can be represented graphically as shown in Figure 1. For the stronger player, welfare payoffs increase as the levels of capabilities converge due to the increased ability of the junior partner to contribute to the joint endeavor. Concern over

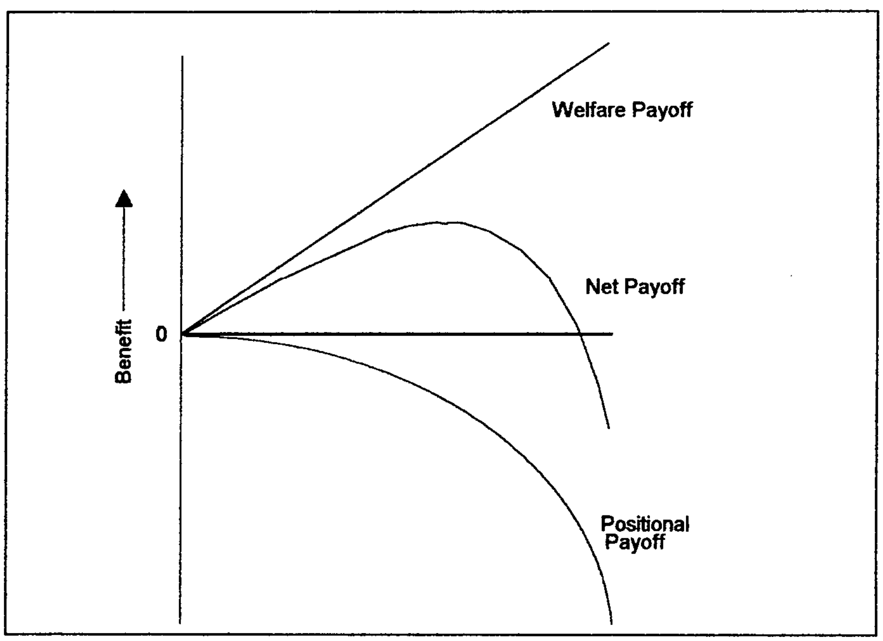

Figure 1. Net Payoff for Stronger Player[28]

[28] Source: Tucker, p. 92

positional losses is small if the disparity in overall capabilities is great since the weaker side will be unable to significantly capitalize on the knowledge acquired. But if the players are nearly equal, any positional change may be unacceptable to the leader since it could jeopardize its leadership position. The conclusion Tucker reaches is that collaboration will be most successful in cases where the disparity in capabilities between the two participants is "moderately large" -- enough that concerns regarding positional losses are not excessive while not so much that the weaker player has nothing to contribute: "Contrary to the conventional wisdom, then, 'equals' do not make the best partners."[29]

When parties with roughly equivalent capabilities consider collaboration, special steps must be taken to mitigate the concerns of positional losses if the endeavor is to succeed. Tucker describes a variety of methods to reduce the stronger firm's *sensitivity* to relative gains by the weaker. The two of these most relevant here are "strict reciprocity" provisions and "strategic alliances." The first consists of measures negotiated by the parties to either guarantee equal shares of the technologically-sensitive work or to equally share new technologies developed through the venture. Such measures increase the complexity of the collaboration but can provide reasonable assurance that both participants will benefit proportionally. The second measure, forming a strategic alliance, reduces positional concerns by tying the players to a common interest that will persist for a relatively long period of time. As Tucker explains,

[29]Tucker, p. 91.

> Until recently, firms participated primarily in ad hoc, contract-specific consortiums in which today's partner could be tomorrow's competitor. As a result, the players had reason to worry that transfers of technology in one collaborative project could boomerang in the next. Over the past few years, however, firms have increasingly sought to hedge against the risk of defection by establishing more stable partnerships ("strategic alliances") extending over a series of projects. A common way for firms to form an alliance is to exchange capital through reciprocal shareholding arrangements, with equity ownership ranging from 5 to 20 percent.[30]

Thus the theoretical material concerning collaboration on international aerospace projects indicates there are factors both supportive of and detrimental to collaboration. The analytical model used herein is Tucker's "Partners and Rivals" model which proposes a method of evaluating benefits to players in mixed motive situations. The model can be applied at both the firm and state levels to provide a composite understanding of the motives of all actors in a given project. The next section will present more detail regarding the interests of state actors so that the PAR model can be applied to specific aerospace projects thereafter.

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[30]Tucker, p. 119.

Part II: Detailed Discussion of National Interests

The factors responsible for the general trends relating to collaboration among firms and states were discussed in the previous section. This section seeks to elucidate in more detail the specific interests of the states covered in this study -- the U.S., Japan, and South Korea. Such a detailed examination of interests is warranted because the determination of national interests rests on a variety of factors specific to each country. Unlike corporations, whose only objective is to maximize profits, states must balance several goals and competing visions of the best means to realize each.

Therefore the term "state interest" is really itself a composite entity, resulting from the summation of all the various domestic interests within the state that vie for supremacy. At any given time a single state will likely have a number of domestic factions attempting to influence the way the state acts on the international level. Recognizing this multiplicity of forces, the discussion of national interests for each country will be divided into three parts. The first two of these are the declared and de facto national interests of the state, the former representing the official foreign policy of the dominant domestic group (i.e., the executive branch) and the latter those other interests that, while not declared as official policy, nonetheless represent significant constituencies that impact state actions or have the potential to do so in the future. The third part is a discussion of the specific impact of high technology on the state's determination of its interests relative to collaborative aerospace projects.

U.S. Interests

Declared Interests

Official U.S. policy for Asia can be divided into geopolitical and economic interests. In May of 1996 President Clinton outlined the basic tenets of the first of these -- U.S. security strategy in Asia -- during a speech before the Pacific Basin Economic Council.[31] The key elements of this strategy included: 1) a continued American military commitment to the region, 2) support for stronger security cooperation among Asian nations, 3) leadership to combat the most serious problems, and 4) support for democracy in the region. As examples of the "most serious" problems he mentioned North Korea and the Peoples' Republic of China. By far the bulk of his speech dealt with China. While refraining from characterizing the country as a "threat," the President cited the facts that it is Asia's only declared nuclear weapons state, that is has the world's largest standing army, and that growth projections indicate it may have the world's largest economy in 20 years. He then characterized China as being at "a critical crossroads" between openness and integration on the one hand and isolation and nationalism on the other. As for the U.S.,

> Our interests are directly at stake in promoting a secure, stable, open and prosperous China -- a China that embraces international nonproliferation and trade rules, cooperates in regional and global security initiatives, and evolves toward greater respect for the basic rights of its own citizens.[32]

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[31]"Transcript of President Clinton's Remarks to the Pacific Basin Economic Council," 20 May 1996, U.S. Newswire.
[32]Ibid.

The security structures through which the U.S. will work to realize these objectives are founded on those already in place from the Cold War -- U.S.-Korean and the U.S.-Japanese security alliances. The first of these, the U.S.-Korean security alliance, has come under increasing scrutiny recently with the end of the Cold War and North Korea's apparent hardship following the loss of support from its former patrons. A study by the RAND corporation and defense officials from the U.S. and Korea concluded that the end of the Cold War had invalidated the propositions upon which the existing security framework was predicated.[33] Therefore the researchers set out to reexamine the current and anticipated interests of both parties to determine the appropriate nature for the alliance in this new environment. According to this study, U.S. interests were presented as: 1) preventing the domination of Northeast Asia by a hostile power or coalition, 2) fostering the development of values and institutions favored by the U.S., and 3) ensuring the U.S. has access to markets and resources.[34] While presented in slightly different terms, this is essentially the same set of priorities set forth by President Clinton.

[33]Jonathan D. Pollack, et al, A New Alliance for the Next Century: The Future of U.S.-Korean Security Cooperation, (Santa Monica: RAND, National Defense Research Institute, 1995), p. 3. This study and its conclusions represent a fairly centrist position on the U.S.-Korea security alliance and its future. The book The U.S.-South Korean Alliance: Time for a Change (Doug Bandow and Ted Galen Carpenter, eds., New Brunswick: Transaction Publishers, 1992) offers a range of views from that of those like the editors who see Korea as now only a peripheral U.S. interest and capable of defending itself to that represented by William Taylor, Jr. and Daryl Plunk who maintain that Korea remains a vital element in the U.S.' Asia strategy and still needs U.S. protection. Two key areas of difference between these camps appear to be the degree to which the observers view the alliance as an element in the U.S.' overall Asian security strategy and the defensive *potential* of the South Korean forces vis-a-vis the North.

[34]Ibid., p. 12.

Yet the end of the Cold War did not eliminate the threat of a North Korean attack. The RAND study noted that before any significant alteration in the alliance would be feasible, one or more of the following "concrete steps" must occur: 1) redeployment of North Korean forces from offensive positions, 2) solution to the nuclear weapons issue, 3) elimination of North Korean biological and chemical weapons facilities, and 4) real North/South dialogue.[35] The study concludes that these conditions must be satisfied before any change in the bilateral alliance structure is likely.

The same conclusion generally holds true for U.S. interests vis-a-vis Japan. This is due in large part to the fact that the stationing of U.S. forces in Japan is predicated on assumptions nearly identical to those for forces in Korea: the immediate concern regarding North Korea and a desire to be strategically positioned to respond to whatever potential threat China might constitute in the future. And as with the Korean case, the structure for achieving these objectives is a continuation, for the short term at least, of the exisiting bilateral security alliance. The 1995 U.S. Department of Defense report, United States Security Strategy for the East Asia-Pacific Region which was supervised by Assistant Secretary of Defense for International Security Affairs Joseph Nye concludes that the U.S. must maintain the current form of the U.S.-Japan security structure and continue to base 100,000 troops in East Asia for at least the next decade.[36] This policy

[35]Ibid., p. 37.
[36]Kenneth B. Pyle, "The Context of APEC: U.S.-Japan Relations," NBR Analysis, (Seattle: National Bureau of Asian Research, 1995), p. 50, and Joseph S. Nye, Jr., "The Case For Deep Engagement," Foreign Affairs, July/August 1995, pp. 90-102.

was reiterated at the September 1996 meeting of the U.S.-Japan Security Consultative Committee which endorsed strengthening the current alliance.[37]

There is also occasional discussion of the restraining role of U.S. forces in curbing any future resurgence of Japanese militaristic nationalism and the added stability this role provides to the region through assuaging the fears of Japan's neighbors and thereby preventing a destabilizing arms race.[38] This reasoning is analogous to that which, when applied to the Korean peninsula, concludes the U.S. forces there serve primarily to prevent the South Koreans from attacking the North. While each of these arguments certainly has merit, it seems that these are ancillary to the primary concerns cited above. Evidence that the U.S. does not intend to totally "contain" its allies comes first from U.S.-backed shifts in command and structures and mission responsibilities such as the transfer of command of U.N. forces in Korea to a South Korean general and encouragement of Japanese participation in peacekeeping and contingency operations.[39] Another indicator of trust is U.S. support for force modernization measures that provide the Koreans with block 50/52 F-16 fighters having capabilities superior to those of models used by U.S. forces and the sales of advanced AWACS and *Aegis* radar systems to Japan.[40] While all of these show the U.S. will not be averse to providing powerful capabilities to its Korean

[37]"Announcement of U.S.-Japan Security Consultative Committee," Kyodo News International, Inc., 20 Sep 96.
[38]See, for example, Joseph Nye, Jr., "Understanding U.S. Strength," Foreign Policy, vol. 72 (Fall 1988), p. 119.
[39]See "Announcement of Consultative Committee." So far the effort to obtain firm commitments of Japanese support in the event of military "contingencies" on the Korean peninsula have led only to studies but the issue is on the table.
[40]"U.S. Shifting to Better-Than-Front-Line Military Exports," Aerospace Daily, 4 Feb 94.

and Japanese allies, it is important to note that the U.S. is working to ensure these capabilities are employed within the context of an alliance framework including the U.S.[41]

The second area of the U.S.' declared interests pertains to the economic well-being of U.S. firms. This aspect of U.S. policy is highly visible in the country's relations with Asian countries, particularly China. President Clinton, in his speech to the Pacific Basin Economic Council, described the value of China as a market for U.S. goods:

> Our economic engagement with China has also achieved real results. China's elimination of more than 1,000 quotas and licensing requirements has helped to fuel a rise of more than 200 percent in United States exports of telecommunications equipment since 1992. China has become our fastest growing export market, with exports up nearly 30 percent in 1995 alone.[42]

The President then went on to discuss the Most Favored Nation trade status issue and justified granting renewal despite disagreement with China on several geopolitical and human rights issues on the grounds that, among other things, revoking MFN "would cede one of the fastest-growing markets to our competitors."[43] Of course part of the rationale is also that through economic engagement, the U.S. can exercise more influence on

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[41]One other aspect of restraining Japanese and Korean capabilities is that of dissuading them from developing and deploying nuclear weapons arsenals. If Japan came to doubt the efficacy of the U.S. security guarantee and perceived its security to be threatened, it would quite likely embark on an immediate nuclear weapons program as is pointed out in the National Research Council's Defense Task Force Report Maximizing U.S. Interests in Science and Technology Relations with Japan, (Washington, D.C.: National Academy Press, 1995), p. 18 and Selig S. Harrison, Japan's Nuclear Future, (Washington, D.C.: Carnegie Endowment, 1996), p. 34. The same calculus likely applies for Korea. Clearly, preventing such proliferation is a U.S. interest that is served by these security alliances.
[42]U.S. Newswire, 20 May 1996.
[43]Ibid.

China's other activities such as arms exports (especially of missile and nuclear technologies) and guarantees of rights for its own citizens and those of Hong Kong after the summer of 1997. But this engagement cuts both ways, as demonstrated by China's threats to withhold valuable contracts in response to what it deems unfavorable diplomatic pressures from the U.S. One of the clearest examples of this pressure came in April of 1996 when China announced it would buy $1.5 billion worth of airliners from Europe's Airbus Industrie rather than Boeing because the European countries refrained from pressuring China over human rights.[44] This action prompted the U.S. to tone down its rhetoric as well, in part as a response to internal pressure from a consortium of U.S. corporations that export to China. Not surprisingly, Boeing was one of the leaders of the group.

The President's former National Security Advisor Anthony Lake recently explained how trade relations and economic benefits for domestic firms have become a more prominent component of U.S. policy:

> [W]e define "national security" in terms of people's daily lives -- and that means not just the military security of our nation, but our citizens' economic well-being as well, a basis for their personal security. In an era where goods and ideas are traded all over the world and where millions of dollars can flash across the planet at the stroke of a computer key, it is clear that our economic welfare is tied to the rest of the world[45]

Lake went on to cite trade negotiations with Japan, the formation of "America's first National Export Strategy," and the importance of moving towards free trade in the Asia-

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[44]David E. Sanger, "Two Roads to China: Nice, Not So Nice," The New York Times, 9 Jun 96, Section 3, Page 1.
[45]speech to the Chicago Council on Foreign Relations, 24 May 1996, U.S. Newswire.

Pacific region as evidence of the increased U.S. interest in furthering the economic welfare of its citizens (and corporations).

Evidence of this comes from the arena of military exports, in which U.S. defense contractors are increasingly being permitted to sell abroad the latest versions of their hardware, at times providing foreign countries systems that have capabilities greater than those available in models used by the U.S. military. Examples include Lockheed's offer of Block 50/52 F-16 fighters to Israel and Korea and General Dynamics sale of the M1A2 tank to Egypt and Saudi Arabia when the U.S. Army couldn't afford to purchase it.[46] In each of the cases the U.S. government made the determination to allow these sales in the interest of promoting the welfare of the defense contractors during a time period of down sizing in the industry and declining military budgets.

So the primary stated interests of the U.S. in Northeast Asia center around maintaining geopolitical stability and furthering the nation's economic well-being. Strategically, the areas of concern include North Korea for the short term and an unpredictable China and possible apprehension of a militarily powerful Japan or unified Korea in the future. Economically the goal is to promote the welfare of U.S. corporations doing business in Asia.

De Facto Interests

There is another area in which constituencies within the U.S. are shaping or have the potential to shape the overall determination of interests. While not currently

incorporated into official policy, it must be included in the discussion of interests because of its potential to shape the way in which the state will act in the future. This is a growing intellectual climate of opinion among scholars of security issues in Asia that favors a move away from the current bilateral arrangements towards a multilateral, regional security framework.

At present, most theorists concede the tensions on the Korean Peninsula make talk of implementing a multilateral approach in the near term premature. But, as noted in the RAND study, once the tensions are reduced, the alliance can shift from the status quo bilateral arrangement to a "profit generating" alliance based on mutual benefit to both parties in terms of broader political and strategic goals. Although several possible structures were discussed, the study concluded that integration into a regional multilateral security framework would provide the optimum benefit to both parties.[47]

The general desirability of such an arrangement was also mentioned in President Clinton's address cited earlier. Others have attempted to provide a more detailed description of how a multilateral structure might be constituted. Researchers at the Brookings Institution concluded that with the Cold War over, the U.S. should move away from a threat-driven approach to security planning and towards cooperative international security arrangements that seek to reduce uncertainty regarding members' intentions and thus overall risk of a conflict. They propose a "Basic Design" for a multilateral system in which 1) all participants are on the same side, 2) all forces are defensively oriented, and

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[46]"U.S. Shifting Toward Better-Than-Front-Line Military Exports," Aerospace Daily, Vol. 169, No. 24, 4 Feb 94, p. 185.

3) there is a primary commitment to mutual reassurance.[48] Andrew Mack advocates a similar approach in his discussion of cooperative security in Asia, which he proposes be based on the premise that the "foe" is potential misunderstanding that leads to "security dilemmas" and "conflict spirals." His prescription is to base a regional security system on 1) reassurance rather than deterrence, 2) transparency rather than secrecy, 3) arms control rather than arms buildup, 4) confidence and security building measures like those used in the Committee for Security and Cooperation in Europe (CSCE), and 5) non-provocative force structures.[49] Although these proposals have not risen to the level of official policy, the consistent recommendation for defensive force posturing is important to note because of the probability it will be a factor in future calculations of the appropriate methods for maintaining regional stability.

Technology Interests

Beyond these declared and de facto interests, there is one additional factor that shapes the determination of U.S. interests in aerospace -- the nature of high technology

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[47]RAND, p. xvii.

[48]William W. Kaufmann and John D. Steinbruner, Decisions for Defense: Prospects for a New World Order, (Washington DC: Brookings Institution, 1991), pp. 68-70.

[49]Andrew Mack, "Security Cooperation in Northeast Asia: Problems and Prospects," Journal of Northeast Asian Studies, Vol. XI, Nr. 2, Summer 1992, pp. 31-32. While he advocates this as the ideal to which Asia and the U.S. should aspire, Mack cites several obstacles that may prevent such an arrangement from being realized. The primary of these are that 1) the countries about which the greatest concerns exist, North Korea and China, have so far demonstrated little interest in participating; 2) the primary security issues involving the U.S. are still predominantly bilateral in nature (China/Taiwan, North/South Korea, and Russia/Japan); and 3) the U.S. perceives that while it may benefit from lower cost of security, it would likely suffer from reduced influence in such bodies and therefore is only a lukewarm supporter of these proposals (pp. 28-29).

itself and the impact of technology transfers on the capabilities of collaborative partners. The key U.S. interest related to technology is ensuring that technologies shared with other nations for a collaborative project do not create unexpected or uncontrolled challenges as the recipients reapply the technologies to other activities. This concern is heightened when collaboration is with a country like Japan or Korea which has adopted a "developmental state" approach to its political economy which intentionally creates a system conducive to the diffusion and re-application of acquired technologies. Two key factors in determining U.S. interests in the area of technology are 1) the nature of technology itself and its inherent fungibility or lack thereof, and 2) the history of technology exchanges with its partners and consequent implications for future policy.

Writing for the U.S. Army War College, Donald Snow describes the nature of the phrase "high technology" as it is used today:

> At heart, high technology refers to the very rapid growth in knowledge development and generation (largely the product of computer and computer-related discoveries), information processing and dissemination (the telecommunications revolution), and a highly diverse set of associated and derivative technologies stimulated by the explosion in computing and telecommunications. A representative list includes electronics (notably chip technologies), computers and microprocessors, communications and information processing, specialty materials, artificial intelligence and robotics, airframes and avionics, smart weapons, computer-aided design and computer-aided manufacturing (CAD/CAM), biotechnology, and catalysis and other chemical processes. The key element has been more or less simultaneous and parallel breakthroughs in computing and communications allowing knowledge to be generated, disseminated, and applied at an unprecedented pace.[50]

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[50]Donald M. Snow, "High Technology and National Security: A Preliminary Assessment," Armed Forces and Society, Vol. 17, No. 2, Winter 1991, p. 244.

The important point of this definition is that the real value of a high technology product is not in the hardware (or software) itself, but rather in the processes used to generate, disseminate, and apply the information necessary to create the product. Thus high technology is an intangible entity that frustrates those who attempt to classify it as a "military" or "economic" quality. Increasingly, high technology developments are termed "dual-use" as the category into which they fall depends solely on the application to which they are put rather than any intrinsic qualities of the technologies themselves. Snow gives the example of laser technology as one which can be applied to both improved commercial fiber optic communication systems and precision guidance equipment for antitank weapons.[51]

This dual-use nature of high technology has led to the notion that such technologies are highly fungible. That is, the know-how embodied in a specific product, for example a piece of military hardware, could be redirected and applied to another product based on similar principles in the commercial market. This assumption has led to much of the current debate over providing military technology to other countries that might then be able to turn it into products that will compete with U.S. goods in the global market. This was one of the key points of controversy in the U.S. Congress surrounding the FS-X/F-2 (see next section), with opponents of the effort arguing that transfers of U.S. military fighter technology to Japan would contribute to Japanese competitiveness in commercial aircraft. Yet as of 1994 (five years into the program), it remained unclear that the Japanese firms had been able to capitalize on the transferred technology in a

[51]Ibid., p. 245.

significant way.[52] The following illustrates some of the difficulties inherent in translating high technology information into actual products in the aerospace industry:

> Perhaps the most critical technology in design is knowing how to make the end product do what it is supposed to do on paper. This is a very difficult process, one that even established players find daunting. Boeing's track record is quite strong in this area. Because the engines are a critical determinant of performance, Boeing audits the engine makers to assess whether new products are likely to meet targeted performance specifications and the estimates the size of any shortfall. This engine audit process is part of Boeing's organizational knowledge base.[53]

This view of technology seems to run counter to the notion that all knowledge is interchangeable and learning is easily transferable to other tasks. Richard Samuels has written on this issue in his distinctions between the U.S. and Japanese military and commercial aviation industries. In the U.S., Samuels sees that what was once a presumed tendency for government-sponsored (DoD or NASA) research to "spin-off" into commercial applications no longer functions that way. Due to extensive regulation of government contracts and security requirements, U.S. aerospace firms have tended to segment government operations from civil production. The result has therefore been what Samuels calls "spin-away" wherein the potential benefits of government investment are lost to the commercial sector.[54] In contrast the Japanese industrial structure -- in keeping with the nation's "developmental state" orientation -- was organized in a such a way as to foster the maximum diffusion of new technologies throughout the industry

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[52]National Research Council, High-Stakes Aviation: U.S.-Japan Technology Linkages in Transport Aircraft, (Washington D.C.: National Academy Press, 1994), pp. 125, 127.
[53]Ibid., p. 118.
[54]Samuels and David Friedman, "How to Succeed Without Really Flying," MIT Japan Program paper 92-01, April 1992, p. 4.

through vertical and horizontal linkages. "As a consequence, defense and commercial technologies interdiffuse -- they "spin-on" and "spin-off" to each other with comparative ease in Japan."[55]

The significance of the these points is that they indicate a method of assessing the risks involved in high technology collaboration. They offer, at least qualitatively, insight into the likelihood a dual-use or military technology that is considered for transfer will be convertible into a commercial technology that might compete with the originator's products (or conversely, that shared commercial technology will lead to a new military capability). One key seems to be the organizational know-how of the recipient for dealing with the technology received. In Boeing's case, the company has been able to keep its Japanese partners working at the subcontractor level in part due to the latter's lack of systems integration experience involving aircraft engines. The second factor is that pointed out by Samuels -- the recipient's organizational structure and the degree to which it fosters or inhibits information diffusion. Both factors are based on the organizational characteristics of the recipient. So returning to the PAR model and determination of national interest, when contemplating a technology transfer to a collaborative partner, the U.S. will need to gauge not only the relative capabilities of its potential partner in the specific technology area involved, but also the management know-how and organizational structures it possesses.

The goal of such an assessment will be to ensure a level playing field exists for competition. This was one of the final recommendations of the National Research

[55]Ibid., p. 4.

Council's report on the U.S. and Japanese aerospace industries.[56] This group concluded that U.S. industry would benefit from U.S. government insistence, through mechanisms such as the GATT (and now WTO), that potential competitors refrain from subsidizing their commercial aerospace industries. But this can have another meaning as well. The U.S. has long maintained that developmentalist approaches to national economies are exclusionary and anti-competitive. At least in Japan and Korea, such growth models are currently showing signs of weakening and the metaphor of Asian "flying geese" following Japan's path to riches has changed to become one in which, as one observer describes it, "the lead goose fell to earth, and the Japanese economy has been flopping about ever since."[57]

This should present an opportunity for the U.S. to continue to encourage these countries to adopt more competitive practices that encourage protections for Intellectual Property Rights (IPR). Encouragingly for the U.S., there is a precedent in the HYPR program led by the Japanese government to develop a Mach 5 turbo-ramjet engine with international assistance. Initially the non-Japanese companies invited to participate, including GE and Pratt & Whitney, objected to the traditional Japanese system in which the government retained effective control of IPR for technologies generated in the project. Through negotiations with MITI, the Japanese changed their IPR laws for such international projects giving ownership of patents back to the companies that generate

[56]NRC, High Stakes Aviation, p. 89.
[57]Walter Russell Mead, "East Asia Needs a New Growth Strategy," The Wall Street Journal, 17 Apr 97, p. A22.

them.[58] This is just one small step but demonstrates that such measures are possible and can be used to make collaboration more likely to succeed. The goal for the U.S. would be to encourage a move away from the diffusion-oriented developmentalist structure through the strengthening of IPR protections and thereby reducing the likelihood that a given technology shared for a specific collaborative effort would be translated into an increased competitive capability in some other area.

Comparing the present bilateral relationships, there is an additional special consideration in technical cooperation with Japan that is not as yet significant for Korea. That is the issue of reciprocity. Recall from the PAR model that success in collaborative efforts is most likely when there is a moderate difference in capabilities between the partners. When the capabilities converge, special measures must be implemented to reduce the sensitivity to positional changes. This is not currently an issue in U.S. technology relations with Korea because, as was noted in the first section, that country does not have sufficient technical capabilities to warrant reciprocity measures. But Japan is another matter. According to the National Research Council's study of U.S. interests in defense relations with Japan, the alliance has been characterized throughout its existence by predominantly one-way technology flows from the U.S. to Japan.[59] This made sense during the Cold War as U.S. military and technological assets were exchanged for Japanese political support. But now with the changed world order and increase in Japan's capabilities, the need for greater reciprocity has likewise increased. According to the

[58]NRC, <u>High Stakes Aviation</u>, p. 140.
[59]NRC, <u>Maximizing U.S. Interests</u>, p. 2.

NRC, the U.S. DoD has shown increasing interest in gaining access to Japanese technologies to meet common security needs:

> In 1980 the Systems and Technology Forum (S&TF) was established between the two countries to explore possible joint R&D projects in military technology. In 1983 the Japanese government announced that transfers of military technology to the United States, and only the United States, would be allowed as an exception to the "three principles" on arms exports.[60]

Yet since 1983 there have been only three programs which transferred military technologies to the U.S.: a naval construction program in 1986, FS-X/F-2 technology in 1990, and ducted rocket engines in 1992.[61] The report concludes that overall, "efforts to date have not resulted in significant Japanese technological contributions to U.S. national security."[62] Thus an important U.S. interest in its technology projects with Japan will be to increase the degree of reciprocity or technology "flowback" from collaborative ventures in the interest of stabilizing the relationship.

It is now possible to summarize the key elements of U.S. interests. From the above discussion, successful collaborative aerospace projects should satisfy the declared, de facto, and technology interests shown in Table 3.

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[60]Ibid., p. 30.
[61]Ibid., p. 35.
[62]Ibid., p. 4.

Table 3. Summary of U.S. Interests

Declared Interests
1) Prevent the domination of Northeast Asia by a hostile power
2) Foster the development of democracy
3) Ensure the U.S. has access to markets and resources
4) Promote U.S. firms' profit-making activities
5) Accomplish these objectives through the existing bilateral alliance system
De Facto Interests
1) Foster an environment conducive to multilateral approaches to security, including defensive force postures
Technology Interests
1) Minimize risks of uncontrolled re-application of shared technologies through measures such as strengthened protections for IPR
2) For Japan, include specific reciprocity provisions

Japanese Interests

Declared Interests

Japan's declared national interests are rooted in its history. The nation's passive stance in international security affairs and emphasis on economic growth and competitiveness has its origins in the U.S. Occupation after World War II and the policies of subsequent Japanese leaders.

The first element of official Japanese international policy is Article IX of the Constitution, drafted by U.S. Occupation forces, which states that

> Aspiring sincerely to an international peace based on justice and order, the Japanese people forever renounce war as a sovereign right of the nation and the threat or use of force as a means of settling international disputes.

> In order to accomplish the aim of the preceding paragraph, land, sea, and air forces, as well as other war potential, will never be maintained. The right of belligerency of the state will not be recognized.

Although some readers of this passage have interpreted this passage as forbidding the country to possess any military capabilities, the record of its formulation makes clear that is not the case. As is detailed in Kenneth Pyle's account, both the original U.S. drafters and the Japanese Diet members who revised the article consciously crafted the phrasing to allow Japan the option to maintain military forces for purposes of self-defense.[63]

Japan did indeed develop self defense forces, but decisions by subsequent Japanese leaders limited the nation's involvement in international security affairs by developing a doctrine of strict defense and near-exclusive concentration on economic recovery. The crucial point at which Japan's official policy orientation was shaped came in the years immediately after World War II when Yoshida Shigeru developed his set of policies that have come to be known as the "Yoshida Doctrine."[64] As it developed, the

[63]Kenneth B. Pyle, The Japanese Question: Power and Purpose in a New Era, (Washington, D.C., The American Enterprise Institute Press, 1992) pp. 9-11.

[64]Selecting Yoshida as the key shaper of Japanese technology policy is somewhat at odds with the view of the NRC (Maximizing U.S. Interests) and other scholars who emphasize Japan's consistent thirst for technology since the Meiji Era. Richard Samuels, for example, traces Japan's drive to acquire foreign technology back to the mid-1800s ("Rich Nation, Strong Army" National Security and the Technological Transformation of Japan, (Ithaca: Cornell University Press, 1994), p. 35). Samuels acknowledges there was some significance in the Yoshida era, writing that Japan faced key decisions on its approach towards technology twice -- in both the Meiji era and the 1950s -- but his emphasis is on the former period as the point at which the process started. My reason for choosing the formulation of the Yoshida Doctrine as the more relevant to the issue of technology exchange is that Yoshida transformed the old goal into its present form which still shapes Japanese society. In the Meiji drive for *fukoku-kyōhei*, the acquisition of technology was inextricable from the quest for military might. If that vision had persisted to the present day, the U.S., concerned as it is with global security issues, might well have had an easier

Yoshida Doctrine included the tenets of focusing on Japan's economic recovery while avoiding international political-strategic issues, all within the context of U.S.-provided security guarantees.[65] The significance of this formulation of national priorities to the discussion of technology collaboration is that it marked a shift away from the immediate dominance of military applications for new technologies that had characterized prewar efforts. This is shown in Michael Green's study of Japanese defense production, Arming Japan. Green describes the debate in the early 1950s after the end of the Occupation over the question of whether or not Japan should rearm. One faction, including industry and hawkish members of the Liberal Democratic Party, favored rearmament and a return to military-driven industrial policy. Others, primarily in the Ministries of Finance and Foreign Affairs, did not oppose rearmament per se but objected to massive domestic buildups due to budgetary concerns and potential strains on the relationship with the U.S.[66] In deciding to focus on economic recovery, Yoshida was striking a middle course that satisfied the industrialists' desire to increase production, the political hawks' desire to build national power, and others' desires to avoid conflict or unproductive spending on the military sector.

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time cooperating technologically with a Japan that had a similar geo-strategic view of the world. Each side would be able to see technology as a mere tool that could be acquired, used, or traded as appropriate according to larger security concerns. But Yoshida, by removing the military variable from the equation, made this similarity of vision unattainable.

[65]Kenneth B. Pyle, The Making of Modern Japan, 2nd Ed., (Lexington: DC Heath and Company, 1996), p. 235.

[66]Michael J. Green, Arming Japan: Defense Production, Alliance Politics, and the Postwar Search for Autonomy, (New York: Columbia University Press, 1995), p. 10.

Through the influence of Yoshida and the dovish factions, the stated elements of Japanese security policy have come to include: 1) "limited defense" role for the Self-Defense Forces only for defense against a limited invasion threat; 2) no overseas deployments of troops; 3) no militarization of space; 4) no offensive weaponry; 5) no alliances or collective security arrangements that commit Japan to the use of force to defend others; 6) no manufacture, production, or introduction of nuclear weapons into Japan; and 7) no weapons exports.[67]

One impact of this minimalist approach to security affairs has been the increased visibility of Japanese economic influence outside its borders, particularly in Asia. As Pyle notes, Japan has a significant leadership position in Asia due to its vast investment and official development assistance in the region.[68] The pattern that has developed has been one of increasing technology and capital flows to Asian countries in support of their development needs. Pyle describes the "New Aid Plan" which typifies this approach:

> It moves through three stages. First, an economic master plan is developed for a target country to identify industries that would be internationally competitive, susceptible to Japanese leadership, and appropriate to a vertical integration. . . . Second . . . a set of specific guidelines for the appropriate industries is worked out, detailing what changes and incentives must be accomplished in order to justify official Japanese support and private investment. Third, a host of official Japanese aid institutions is brought into play to implement a program of construction and investment.[69]

[67]David Arase, "A Militarized Japan?" in Desmond Ball, ed., Transformation of Security in the Asia/Pacific Region, (London: Frank Class & Co., Ltd., 1996), p. 85.
[68]Pyle, Japanese Question, p. 131.
[69]Pyle, Ibid., pp. 135-136.

The benefit for Japan of such engagement, aside from straightforward exports and access to materials, has been in increasing the ability of Japanese firms to move labor-intensive production facilities offshore. This allows labor costs of the final manufactured goods to be kept down and the final prices of export goods competitive internationally.

De Facto Interests

In addition to the nation's declared interests, there is another group of undeclared interests pursued by domestic factions whose power has been great enough to influence the course of national actions and yet insufficient to make significant modifications in the country's declared policy. A theme that pervades these de facto interests can be termed "strategic positioning." The Japanese have worked within the framework of the U.S. alliance while seeking to increase capabilities in preparation for at time when they will begin to act with greater autonomy.

Returning to the historical antecedents for current policy, even Yoshida never intended that his emphasis on economic issues and aversion to military uses of technology and involvement in strategic affairs would be a permanent condition. This is revealed most clearly in a statement Yoshida made to Miyazawa Kiichi long before the latter became prime minister:

> [T]he day [for rearmament] will come naturally when our livelihood recovers. It may sound devious, but let the Americans handle [our security] until then. It is indeed our Heaven-bestowed good fortune that the Constitution bans arms. If the Americans complain, the Constitution

> gives us perfect justification. The politicians who want to amend it are fools.[70]

Clearly Yoshida intended that after Japan had sufficient time to build its economic strength, it would return to a position of influence diplomatically and militarily. Indeed, by the time Ohira Masayoshi came to be prime minister in 1978, there was a growing group of Japanese leaders who felt it was time for the country to regain some balance in its affairs. According to a group of defense specialists commissioned by Ohira,

> U.S. economic strength has declined both in absolute terms and in relative terms against the economic development achieved by Europe and Japan. As a result, it has become impossible to primarily rely upon the United States as in the past....It has become impossible for Japan to pursue solely its own economic interests within this system.[71]

Yet making the transition would not prove easy. Pyle documents the efforts of several Japanese leaders, especially Nakasone Yasuhiro, to bring a "New Internationalism" into Japan's conception of its interests.[72] Yet these reformers were challenged by opposition forces that decried their aims as militaristic and ultimately kept the new agenda from fully coming to fruition. The success of Yoshida eventually became the leading element of what Pyle terms "the Burdens of History" in that Japan is now divided between those who would restore some balance and others who, for the moment, hold to the status quo. The

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[70]Quoted in Kenneth B. Pyle, The Japanese Question: Power and Purpose in a New Era, (Washington, D.C., The American Enterprise Institute Press, 1992), p. 26.
[71]The Comprehensive National Security Study Group, "Report on Comprehensive National Security," in Yuichiro Nagatomi, ed., Masayoshi Ohira's Proposals: To Evolve the Global Society, (Tokyo: Foundation for Advanced Information and Research, 1988), p. 224. This was one of several study groups whose works provided the intellectual foundation for the new internationalism.
[72]Ibid., pp. 65-105.

internationalists are working quietly and in small increments to prepare Japan for active military and diplomatic roles for the time when it will become feasible.

There is considerable evidence that the influence of these internationalists is having an effect as Japan is putting in place the components for a military force with expanded independent capabilities. In 1983 the limit on weapons exports was amended to exempt technology related to the Strategic Defense Initiative exchanged with the U.S. Japanese forces have gone abroad on five occasions -- minesweepers to assist the U.S.-led coalition in the Persian Gulf and peacekeepers for U.N. operations in Cambodia, Mozambique, Rwanda, and the Golan Heights.[73] And diplomatically Japan has taken steps that could presage a regional security role by trying to place security issues on the agenda for meetings of ASEAN and the ASEAN Regional Forum (ARF).[74] Some observers interpret current Prime Minister Hashimoto Ryutaro's proposal for annual summits between ASEAN and Japan to mark what amounts to a new "Hashimoto Doctrine" of engagement in regional security issues.[75]

In terms of military force structure this positioning has taken the form of creating the capabilities necessary for meaningful military activities should such become necessary and domestically palatable. Japan has a capability to assemble considerable conventional and nuclear forces. Conventionally, its forces include 64 major surface combat ships, 4 *Aegis* radar-equipped cruisers, 15 attack submarines, 85 patrol aircraft, 92 antisubmarine

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[73]Barbara Wanner, "United States, Japan to Explore Expanded Defense Cooperation (Part 1)," JEI Report, No. 20, Vol. 1996, 24 May 96.
[74]Ibid., p. 88.
[75]"Japan's Diplomatic Offensive," The Wall Street Journal, 24 Jan 97, p. A14.

helicopters, 154 F-15 fighters, and 4 Boeing AWACS aircraft.[76] And more important than just the numbers of systems is the manner in which they are employed. Japan may be preparing for extended sea route control through the use of Maritime Action Groups (MAG) capable of projecting power far from Japan's shores. This combination consists of an *Aegis* cruiser, a destroyer, a frigate, and an attack submarine. In 1994 Japan sent one of its destroyer groups led by the *Aegis* ship, *Kongo*, and accompanied by a submarine, a supply ship, and 8 P-3C Orion antisubmarine patrol planes to the RIMPAC naval training exercise.[77] Japanese defense planners may also be looking to develop a small aircraft carrier, having received authorization in 1994 to build a fast transport ship with a side-mounted bridge tower that, according to Jane's Fighting Ships, "would be capable of operating VSTOL aircraft should such a development become politically acceptable, at some time in the future."[78]

There is also evidence that Japan is keeping its options open regarding nuclear weapons. In his study of Japan's nuclear weapons potential, Selig Harrison finds the country has at its disposal all of the elements necessary for their production. These include:

> - Supergrade plutonium: recovered from Japan's breeder reactor program and reprocessed in the Recycling Equipment Test Facility, to be completed in the year 2000.
>
> - ICBMs: The J-1, M-5, or H-2 rockets could be converted to missile use and carry payloads sufficient for nuclear weapons.

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[76]Arase, pp. 88-89.
[77]Ibid., p. 90.
[78]Ibid., p. 89.

- Targeting: NASDA developed guidance and reentry technologies sufficient for targeting cities (i.e., for "countervalue" strategies) through the OREX reentry vehicle tests.[79]

Japanese leaders have acknowledged that Japan has the capability to produce nuclear weapons, if it chose to do so.[80] But for the time being, they have not so chosen. Harrison quotes a Japanese security specialist as forecasting that Japan will not exercise its option to develop the weapons unless 1) the nuclear powers fail to abide by Article 6 of the Nuclear Nonproliferation Treaty which obligates them to move towards reducing their own weapons stockpiles, 2) Japan perceives an increased military threat from Russia, China, or North Korea, and 3) Japan loses confidence in the U.S. nuclear security guarantee as a deterrent to Russian, Chinese, or North Korean military pressures.[81]

Similar to this strategic positioning in diplomacy and defense is Japan's acquisition of capabilities in civilian aerospace. As is the case in these other areas, there are conflicting domestic interests that keep the country balanced on the verge of great advances but somehow not quite making the commitments to see them through. In her study of the Japanese space program, Joan Johnson-Freese describes the more well known areas of Japanese effort such as the H-2 rocket and participation in the international space station. She then discusses what she calls "the creative fringe" of imaginative projects including solar energy stations in earth orbit and a global earth

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[79]Selig S. Harrison, Japan's Nuclear Future, (Washington, D.C.: Carnegie Endowment, 1996), pp. 20-22. These items were summarized, not quoted.
[80]Ibid., pp. 24 (Prime Minister Hata Tsutomu), 29 (Foreign Minister Muto).
[81]Ibid., p. 34.

observation satellite system.[82] Private Japanese construction companies have been looking ahead as well, with plans for a "space hotel" in orbit and another on the moon.[83] And yet space budgets in Japan remain small, constrained by deficit-conscious MoF bureaucrats. Summarizing Japan's approach to investment in space, John Logsdon, Director of the Space Policy Institute, writes,

> Japan is best understood as an emerging space power. It has put forth, but not made a commitment to, an ambitious space plan for coming decades....Japan's space policy is [one of] *strategic positioning*, defined as creating the capabilities for a breakout program if Japanese leadership decides to go into space in a big way. There are vocal advocates of space in Japan, but they have not yet carried the day. [emphasis added][84]

Thus the approach to space mirrors that to defense: while a visionary group of leaders works to steer the country towards increased capabilities and responsibilities, they are held in check by other domestic groups that prevent them from doing more than creating potentialities that may be realized in the future. This transition will have a significant impact on Japanese participation in collaborative ventures.

Technology Interests

Another factor impacting Japanese participation in international aerospace projects is the attitude of many Japanese policy-makers towards technology itself. One aspect of Yoshida's initial compromise on which all sides could agree was the advancement of technology, while the application to which this technology would be put

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[82]Johnson-Freese, pp. 155-165.

[83]Karl Schoenberger, "Japan Eyes Stardom in Space: Prospects of Traversing the Heavens Leave the Nation Moonstruck over the Scientific -- and Commercial -- Possibilities," The Los Angeles Times, 12 Feb 90, p. A1.

was left to each group to determine. To those in the military, technology meant domestic production of weapons systems; to MITI it meant increased competitiveness of exports; to MoFA it was pride and a bargaining chip; to industry it meant increased production know-how across the board. One outcome of this divorce of technology from military might was the virtual enshrinement of technology as an abstract ideal, viewed as a source of power and pride but without regard for the tangible ends to which it would be applied. Now rootless, technology is still sought but often without clear end uses in mind. Instead vague, generalized notions that technology is good, useful, and will eventually bring benefits to its possessors seem to drive much of Japan's efforts to acquire (and retain) technology.

Observers of Japanese technology acquisition efforts have described the underlying motivation in various ways. Michael Chinworth points out two motives: pride and national security. The Japanese are proud of their technological accomplishments in developing a "world class" aircraft industry.[85] At the same time concern for national security is a driving factor, but not in the strictly military sense of the pre-Yoshida days:

> Japanese defense technology strategies are intertwined with a broader process of technology management in government and industry that emphasizes the nurturing of dual-use technologies to ensure Japan's security in the broadest sense during the coming century. It is essential to look beyond narrow definitions of security to appreciate the thrust and implications of Japanese defense technology management.[86]

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[84]John M. Logsdon, "Japan's Strategic Positioning," AD Astra, Feb 91, p. 3.
[85]Michael Chinworth, Inside Japan's Defense, (Washington, Brassey's (U.S.), Inc., 1992), p. 138.
[86]Ibid., p. 38.

This is "comprehensive security" in its broadest sense. Samuels, too, starts with the conception of security needs driving technology acquisition but then moves into less focused terminology when he describes "technonationalism" as an ideological "belief that technology is a fundamental element in national security, that it must be indigenized, diffused, and nurtured in order to make a nation rich and strong."[87] Each of these descriptions captures aspects of the way in which the Japanese hold an almost mystical view of technology as a disembodied entity with value in and of itself. It has become, as Samuels writes, a "holy grail."[88]

Two specific examples serve to illustrate the way in which the Japanese have pursued technology as an ends rather than a means. The first was the T-2 trainer aircraft program from the 1960s. Despite the availability of off-the-shelf aircraft from the U.S., MITI proceeded with domestic development of the aircraft. The vehicle ultimately cost twelve times what the U.S. alternative would have and had significantly poorer performance.[89] The plane's record earned it the reputation among Japanese military pilots of being "a trainer for industry, not pilots."[90] A second example is the Advanced Turbo Prop (ATP) engine project initiated in 1986 to develop an advanced, highly efficient, low polluting aircraft engine. The government provided subsidies to a consortium of 34 private firms which conducted the R&D. Although the participants spoke of goals such as competing with Western firms and expanding global market share, this was at best a

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[87]Samuels, "Rich Nation", p. x.
[88]Ibid, p. ix.
[89]Green, p. 22.

hope for the distant future. Market surveys in 1985 had shown there was no foreseeable market for the engine among either the U.S. military or the commercial airlines. In reality it was, in the words of one industry participant, "seeds- rather than needs-driven."[91] Both of these examples could be interpreted as training projects, in which the practical objective was increased capability for producers rather than utility to consumers. Such a view would be in keeping with conventional assessments of the orientation of the Japanese political economy and would be correct to a point. But eventually training ceases to be practical if it is not translated into real products with their own merits. And while it is impossible to assess what products Japanese aerospace companies might turn out in the future, the record to date indicates little success in cashing in on this training. Indeed since the beginning of the F-2/FS-X project in 1990, the trend has been away from production of entire airframes in favor of work on subcomponents for U.S. manufacturers such as Boeing and McDonnell Douglas.[92] What these examples do demonstrate is the ideological approach that characterizes much of the Japanese quest for technology. The significance for attempts at collaboration with the U.S. is that since the technology is not differentiated from its application it becomes extremely difficult for Japanese participants to relinquish any technology whatsoever.

Japanese interests are summarized in Table 4 on the following page.

[90]Ibid., p. 16.
[91]Samuels, "Rich Nation", p. 282.
[92]Green, pp. 116-117.

Table 4. Summary of Japanese Interests

<u>Declared Interests</u> 1) Concentrate on domestic economic growth and development 2) Promote economic engagement with Asia 3) Maintain the U.S. alliance as the primary security guarantee 4) Limit entanglement in other security matters such as alliances, nuclear weapons, or weapons exports <u>De Facto Interests</u> 1) Incrementally develop conventional and nuclear military capabilities to prepare for more independent actions when feasible or required 2) Strategically position civil aerospace industry for future growth <u>Technology Interests</u> 1) Maintain position as a net technology importer

Korean Interests

<u>Declared Interests</u>

Of course the first issue that appears in any discussion of Korean interests is that of security from invasion from the North. While this is an important issue (and indeed, the dominant security concern in the near term) it is not the only consideration facing the country's planners. The nation is also looking beyond the issue of immediate survival and planning for sustained growth into the future. Statements of national objectives thus contain both military and economic components. According to one Korean defense official, the country's immediate goals are twofold -- national unification and prosperity:

> Defense capability will doubtless be the backbone of these national objectives and strategies. First and foremost, South Korea's military capability should be strong enough to deal with the North Korean military threat, independently or in cooperation with the United States as necessary, and to back up peaceful unification. Second, it should also assure Korea

> of its surrounding military and strategic environments which are secure, stable, and favorable to its way into the group of advanced nations.[93]

The same general priorities of security and prosperity are expected by some observers to persist even after unification. For example, the RAND study that was cited earlier assesses Korea's vital interests both currently and post-unification as

1. Ensuring political viability
2. Maintaining national sovereignty and security
3. Creating the conditions for long-term economic development[94]

Some Korean defense planners even use the label "comprehensive" in the same sense as the Ohira study group to indicate this integration of military and economic facets of national security.[95]

De Facto Interests

The significance of this dual emphasis on military and economic matters is that it means the country is dividing its limited resources between the two objectives. This makes maintenance of the security alliance with the U.S. even more important as it reduces the resources Korea must allocate to the military, thereby enabling the country to pursue both goals simultaneously. Edward Olsen estimates that while Korea currently designates from 5-6 percent of its GNP to defense, without U.S. assistance the figure would have to jump to between 10 and 11 percent to assure adequate security against the

[93]Yong-Ok Park, "Korea's Defense for the 21st Century," Korea and World Affairs, Vol. XX, No. 1, Spring 1996, p. 29.
[94]RAND study, p. 12. (summarized, not quoted)
[95]Changsu Kim, "Competing Security Needs of the Republic of Korea in the 1990s: In Search of a Peaceful Reunification," in Bandow and Carpenter, U.S.-South Korean Alliance, p. 60.

threat from the North.[96] Clearly this additional amount of resources is of great assistance to Korea's economic growth. This means that Korea has an unstated interest in maintaining the U.S. security alliance for *economic* reasons as well as the more widely acknowledged military ones.

The notion of growth is important outside the economic sphere as well. Korean planners are looking at expanding their nation's security horizons beyond the North Korean threat to encompass the regional security framework after unification. Yong-Ok Park describes this as the second aspect of Korea's "dual security task" -- preparing for vaguely defined "strategic uncertainties" in East Asia:

> Thus the traditional defense concept of physical survival against identifiable threats is now being reshaped, focusing on safeguarding of national interests against multiple uncertainties.[97]

Such future issues clearly include China, and in the minds of some Korean defense planners at least, Japan. As mentioned previously, some observers perceive a multilateral security arrangement as the optimal approach to handling such issues from several perspectives, including that of Korea's interests.[98]

Technology Interests

The Korean approach to high technology is consistent with its overall goal of increasing its military and economic capabilities. According to an OECD study of Korea's science and technology policy, the country's leaders have a "mid-entry" strategy

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[96]Edward A. Olsen, "Korean Security: Is Japan's 'Comprehensive Security' Model a Viable Alternative?" in Bandow and Carpenter, pp. 149-150.
[97]Park, p. 26.

for high technology which seeks to use domestic R&D to exploit technologies initiated abroad in order to accelerate the pace of growth.[99] To achieve this goal, Korea has actively sought out international partners as sources of technology. So far the leading source of technology is Japan. Out of 631 bilateral international projects initiated between 1985 and 1994, 182 were with Japan and 115 with the U.S.[100] But the trend appears to be shifting. Some Koreans express a preference to work with U.S. partners due to a perception that Japanese collaborators are reluctant to share technology, preferring to provide "show-how" rather than know-how.[101]

Part of the reason for the switch may also be the growing maturity of Korean technical capabilities, meaning they are looking for higher-level technologies more frequently found in the U.S. Like Japan, Korea is known as having strong capabilities in the manufacture of components and assembly and processing while being weaker in systems integration. And like Japan of a few years ago, Korea is known as being weak in basic research.[102] So even though Korea is still considerably behind Japan technologically, it make sense that it would look for partners that had strengths in areas it was weak in. Termed "complimentarity," this approach of matching a partner's strengths to one's own weaknesses forms much of the incentive to collaborate. It is through such complimentary collaboration that Korea is hoping to increase its capabilities.

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[98]RAND study, pp. 30-31; Park, p. 30.
[99]OECD, Reviews of National Science and Technology Policy: Republic of Korea, 1996, p. 175.
[100]Ibid., p. 112.
[101]Simon and Soh, p. 21.
[102]Simon and Soh, p. 24; OECD, p. 20.

This desire to increase capabilities is a factor in aerospace collaboration between Korea and the U.S. as well. At the moment Korean firms are using their strengths in assembly and processing technologies to license produce aircraft such as the F-5, F-16, and UH-60. They are also producing component parts under offset agreements for Boeing and McDonnell Douglass.[103] But this is not the state they wish to remain in indefinitely. Korean defense planners have called for an increased flow of defense-related technologies from the U.S. to Korean firms as well as an increase in the portion advanced weapon systems composed of domestically-produced components ("local content").[104] The goal of both of these measures is to allow domestic Korean firms to increase their abilities to produce high-technology defense equipment at home.

Table 5. Summary of Korean Interests

Declared Interests
1. Protect against North Korean threat
2. Promote national unification
3. Promote economic growth
4. Maintain U.S. alliance
De Facto Interests
1. Minimize defense spending (allocate more resources to economy)
2. Protect against regional "uncertainties" in China and Japan
Technology Interests
1. Transfer of know-how to Korea
2. Increased local content
3. Build on strengths in assembly and process technologies

[103]Simon and Soh, p. 31.
[104]RAND study, p. xvii; Park, p. 33.

Part III: Case Studies

Now that the general trends and specific national interests in the realm of collaboration have been examined, this section will present a detailed analysis of four current major aerospace projects. Three of the projects are collaborative -- two U.S.-Japan and one U.S.-Korean -- while the fourth is a unilateral effort that has been included for comparison. The analysis of each project will begin with a brief description of the project's background and objectives. The PAR model will be used to assess the net payoff for both state and firm actors based on their relevant interests in order to predict whether or not collaboration should occur. Then the actual collaborative status of the project will be presented for comparison with the theoretical result along with any other observed anomalies not predicted by the model. Finally these results will be combined to assess and refine the PAR model.

F-2 / FS-X

Project Description

The F-2 fighter, originally designated the FS-X, was initially intended by the Japanese to be the first combat fighter aircraft produced with entirely domestic technologies. Michael Green describes the history of the project as follows:[105] Growing out of the groundwork laid in the late 1960's, the Japanese Defense Agency (JDA) developed an interest in building a domestic combat fighter. First formally proposed by

[105]Michael J. Green, "Alliance Politics and Technonationalism: Japanese Policy Making on the FS-X," George Washington University, 8 Jun 93, pp. 7-9, 28-29.

the military in 1975, the Aircraft and Ordinance Division of the Ministry of International Trade and Industry (MITI) endorsed autonomous development in 1982. On 2 April 1985, a JDA technical review concluded autonomous development was feasible and recommended production of 250 aircraft. Then, beginning in June of 1985, the Reagan Administration began pressuring the Japanese government to purchase an off-the-shelf U.S.-made fighter due to concerns that an autonomous program could create strains on the security alliance and lead to commercial competition for U.S. aerospace companies.[106] What followed was a period of nearly five years of high-pressure negotiating and political maneuvering on both sides. The eventual contract, signed on 21 February 1990, called for Japan and the U.S. to "co-develop" a new Japanese fighter based largely on the General Dynamics (now Lockheed Fort Worth Division) F-16. Japanese companies under the prime contractor Mitsubishi Heavy Industries were to receive extensive technical data on the F-16 and purchase engines for at least the six prototype aircraft. U.S. companies were guaranteed a 40% share (currently valued at over $1 billion) of the work and "flowback" rights to technologies developed during the project.[107] The primary technologies the U.S. anticipated receiving through the effort included information pertaining to:

- design and manufacturing processes for composite materials
- active phased array fire control radar
- mission computer

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[106]Peter Dauvergne, "U.S.-Japan High-Tech Military Cooperation: Implications of FSX Co-Development," Asian Perspective, Vol. 17, No. 2, Fall-Winter 1993, pp. 193-194.
[107]If the technologies are "derived" from U.S.-provided technologies, the U.S. companies receive them free of charge. Transfer of "non-derived" technologies must be negotiated and may require payment. See GAO report for details.

- integrated electronic warfare system
- inertial reference/navigation system
- radar absorbing materials[108]

Flight testing of the first prototypes is currently underway.

PAR Analysis

The key input factors in the PAR model are relative capability, welfare payoffs, positional payoffs, and sensitivity-reducing factors (reciprocity and alliances). The model assumes welfare benefits accrue roughly evenly to both actors while positional benefits favor the weaker side. Conducting the net payoff analysis twice -- for the corporate and state levels -- should provide a composite assessment of the prospects for the collaborative undertaking. This section will subject the F-2 to this analytical approach in order to determine the degree to which the model succeeds in describing reality.

Determining the ratio of capabilities for the state and firm levels requires a qualitative assessment of the U.S. and Japanese aerospace industries and the larger technological settings they inhabit. Until recently there was little doubt that the U.S. held the clearly dominant position. But a 1992 U.S. DoD assessment rated Japanese technical strengths as "moderate" in 9 of 11 categories deemed to be critical to national strength and competitiveness and "broad" (the highest) in 6 of 41 subareas.[109] This, combined with popular conceptions of Japanese technical prowess arising from their demonstrated

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[108]U.S. GAO, "U.S.-Japan Cooperative Development -- Progress on the FS-X Program Enhances Japanese Aerospace Capabilities," 11 Aug 95.
[109]NRC, Maximizing U.S. Interests, pp. 32-33. Yet it is important to note that there is considerable variation among such assessments. For example, a more alarmist National

success in automobile manufacturing, led many to conclude Japan was on the verge of achieving parity with the U.S. in aerospace as well. So for this PAR input the difference in capabilities will be categorized as "small."

The following two tables show the issues involved in the assessment of corporate and state interests. For simplicity, only the names of the two prime contractors are shown in Table 6 although in fact the impact of technology transfers has extended far beyond these two firms.

Table 6. Firm-level PAR Analysis for F-2 (FS-X)

<u>Welfare Payoffs</u> Revenue generation
<u>Positional Payoffs</u> Design, development, and production experience (Mitsubishi) Access to F-16 and engine data (Mitsubishi) Access to new manufacturing techniques (Lockheed) Access to composite and radar technologies (Lockheed)
<u>Sensitivity Reducing Factors</u> Work share guarantee Technology "flowback" provisions

These tables provide several important results for the evaluation of the PAR model. The first is that the model does appear to be useful in at least a taxonomical sense in that it facilitates classifications of the factors involved. Although quantitative application of the model is not possible, it would seem to indicate the project should have a good chance of success since the positional payoffs appear balanced and there are

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Academy of Engineering study in 1987 found the Japanese to be *superior* to the U.S. in 25 of 34 high technology areas (Dauvergne, p. 184).

sensitivity-reducing factors present. Thus the theory indicates the net payoffs for both the firm and state actors are conducive to collaboration -- a prediction validated by the real continued success of the project.

Table 7. State-level PAR Analysis for F-2 (FS-X)

Welfare Payoffs
Solidify bilateral security alliance
Improve Japanese defense capabilities as old F-1 is replaced
Positional Payoffs
Improve capabilities of domestic aerospace industry (Japan)
Improve capabilities of domestic aerospace industry (U.S.)
Work share guarantee
Sensitivity Reducing Factors
U.S.-Japan strategic alliance
Work share guarantee
Technology "flowback" provisions

And yet some anomalies also appear. The PAR model does not predict positional payoffs that benefit the stronger partner (Table 6). Nor does it provide guidance in assessing situations where both partners could be perceived as gaining precisely the same positional advantage. The results shown in Table 7 are clearly impossible. Either the benefits to the domestic aerospace industries should really be welfare benefits shared by both, or the positional benefits do not accrue evenly and thus really apply to only one player.

Perhaps these anomalies are products of the relatively slight difference in capabilities between the partners. With a narrow differential, the flow of capabilities should tend to be more bi-directional. This will create opportunities both for benefit and for controversy. The benefits come from increased transfer of technologies useful to both

parties. The controversy arises as there are differences of opinion between the players and among constituencies within each player's group as to the true value of the positional transfers. Thus the primary loci of debate over the FS-X were in the U.S. Congress and the Japanese Diet, as legislators disputed the claims by executive branch entities that the transfers were aiding domestic industry.[110] This causes some difficulties for the PAR model as it does not distinguish explicitly between executive and legislative branch interests. Nor does it account for other types of domestic dissent regarding the definition or calculation of national interest. Therefore the analysis is more complicated in this study, which includes both declared and de facto interests.

There is little doubt that the project contributed materially to an increase in the capabilities of the Japanese aerospace industry. The controversy centers on the extent of the concurrent benefit to the U.S. aerospace industry. Will the $1 billion in revenue U.S. firms are generating for "20-year-old technology" really allow them to continue to innovate at an ever-increasing rate and increase their positional advantage?[111] Or will $1 billion one day look like a prudent investment by the Japanese to move ahead in aerospace technology? This inability conclusively to settle potentially crucial questions

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[110] For an example of legislative discontent, see Ishihara Shintaro, "From Bad to Worse in the FSX Project," Japan Echo, Vol. XVI, No. 3, Autumn 1989, pp. 59-62. The U.S. Congress also commissioned at least two GAO studies on the issue while the upper house held a "Sense of the Senate" vote in 1987 to express its desire that Japan buy a U.S. fighter (Dauvergne, p. 193).

[111] Moran and Mowery argue that this is possible in the case of aerospace, in which the pace of change is high enough that successive generations of technology rapidly supplant previous ones: "a joint venture strengthens a lead firm's position for the next round of competition by enabling it to use contemporary technology as a "cash cow" to support development of the subsequent generation," p. 235.

of positional payoff may be one of the greatest weaknesses of the PAR model: For the model to be useful, it would seem that the major positional concerns must already be answered. But perhaps certain knowledge of the outcome is not essential after all. What may be more important is the expectation each player holds while entering into the bargain. As long as each perceives collaboration is to their advantage (a positive net payoff), the project will succeed.

H-2 Rocket and LE-7 Engine

Project Description

The H-2 rocket and its LE-7 main engine are not collaborative projects. It is precisely this lack of foreign (i.e., U.S.) technology assistance that makes this project distinct from all previous Japanese space efforts and warrants its inclusion in this study as an example of a case in which collaboration failed to occur.

The background for the project begins in 1966, when the U.S. ambassador to Japan, U. Alexis Johnson, initiated efforts to promote technical cooperation between the two countries. As described by Joan Johnson-Freese in her book on the Japanese space program, he devised a plan to transfer space-related technologies to Japan as part of a larger political agenda of strengthening the overall bilateral relationship.[112] NASA and DoD objected but were eventually overruled when Johnson became undersecretary of State for Political Affairs in 1969. That year the first U.S.-Japan cooperative space agreement was signed. Continuing until 1984, this agreement allowed Japan to purchase

[112]Johnson-Freese, Over the Pacific, pp. 125-126.

licenses to U.S. space technologies not available to any other countries, though the U.S. continued to withhold access to key areas such as inertial guidance, spacecraft stabilization, and cryogenic propulsion. By including restrictions in the licenses for these technologies, the U.S. could exercise control over payloads (especially those of third countries) launched on Japanese vehicles in keeping with U.S. foreign policy objectives.[113]

Since 1975 Japan produced a total of 24 rockets that combined U.S. and domestic technologies in three configurations: the N-1, N-2, and H-1.[114] Each of these uses a liquid-fuel first-stage engine licensed from Rocketdyne. The N-2 also used U.S. technology for the second stage, licensed from Aerojet; the N-1 and H-1 each use indigenous technologies for their second stage engines, designated the LE-3 and LE-5, respectively. The H-1 is essentially a continuation of the hybrid indigenous/licensed approach and was in fact originally designated the N-3 until it was changed due to a desire to dissociate the program from the "heavy connotations of technology transfer that accompany the N-series names."[115]

In 1984 the U.S. side terminated the space agreement with Japan due to growing concerns that the technology transfers were allowing Japan to develop capabilities that

[113]Schoenberger, "Stardom in Space," p. A1.
[114]Godai Tomifumi, *"H2 roketto 1-goki no uchiage,"* Nihon Kōkuu uchuu gakkaishi ("Launch of H-2 Rocket No.1," Journal of the Japan Society for Aeronautical and Space Sciences) Vol. 42, No. 482 (March 1994), pp. 169-171.
[115]Neil W. Davis, "Domestic Makers Building up Rocket Systems Technology," Nihon Keizai Shimbun, 10 Mar 86, p. 18.

would soon threaten U.S. interest in this vital sector of the economy.[116] The combination of the decrease in U.S. willingness to share technology and the blow to NASA's reputation caused by the *Challenger* accident prompted the Japanese to look for independent access to space. Thus was born the drive for a completely domestic launch vehicle that produced the H-2 rocket and its LE-7 main engine.

The goal of the H-2 program was to produce a rocket with "the ability to compete financially with the other rockets in the world" and sufficient "flexibility" to accept payloads "without restrictions from foreign countries [i.e., the U.S.]."[117] To accomplish this goal the Japanese had to develop the technologies formerly withheld by the U.S. The first of these -- spacecraft guidance -- was tackled by a team of five companies including NEC and Mitsubishi Space Software that produced the first domestic inertial guidance system.[118] There was apparently relatively little difficulty in this process as there were no reported failures during development. Flight results bore out the system's accuracy, as shown by the relatively small errors in the trajectory of the experimental geosynchronous transfer payload of 50km at the apogee altitude of 36,261km and 800m at the perigee altitude of 449km (0.13% and 0.18%, respectively).[119]

Development of the cryogenic propulsion system was another matter. The H-2's LE-7 engine uses a complex high-pressure, staged combustion approach, not used in any launch system in the world apart from the technology-intensive U.S. space shuttle's main

[116] Johnson-Freese, Over the Pacific, p.126.
[117] Godai., p. 169.
[118] Davis, p. 18.
[119] Godai, p. 170.

engines.[120] From the beginning this presented a significant hurdle for engineers at Mitsubishi Heavy Industries and Ishikawajima Harima Heavy Industries, the prime engine contractors, despite their earlier experiences with the domestically-developed and produced LE-5 and LE-5A:

> The program was confronted by a succession of problems during the entire development phase including oscillation of the turbine axis, damage to the turbine blades, meltdown of the combustion chamber, and engine explosion due to structural failure.[121]

These setbacks delayed the first launch of the H-2 by over two years. But when the launch finally occurred, one Japanese commentator labeled it "a 260-ton declaration of independence from U.S. aerospace technology."[122]

PAR Analysis

The application of the PAR model to this case differs slightly in that it did not progress to the point of involving private companies on the U.S. side, meaning that only state-level issues need be analyzed.

As was the case in the discussion of the F-2, the difference in capabilities between the two states will be characterized as "small." This is supported not only by the facts regarding general technological development cited previously, but also in the actions of

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[120]John M. Logsdon, "U.S.-Japanese Space Relations at a Crossroads," Science, Vol. 255, 17 Jan 92, p. 298.
[121]Goadi, p. 170.
[122]Norri Kageki, "H-2 Launch Puts Japan in Space Race: Independent Technology Gives NASDA Free Hand, But Commercial Viability Remains Uncertain," The Nikkei Weekly, 7 Feb 94, p. 1.

the U.S. government in terminating the Space Agreement in 1984 on the grounds that Japan was becoming a potential technical competitor.

The issues can be represented in the PAR categories as shown in Table 8. In this table, only the welfare benefit of providing increased ties in the bilateral relationship would have been served by a collaborative effort. Each of the positional goals directly conflicts with an opposite goal of the other party. This clearly illustrates why collaboration on this project was not likely to succeed -- Japan's sole intent was to improve its capability vis-a-vis the U.S. which is precisely what the U.S. sought to prevent.

Yet while the PAR framework was useful as a tool for laying out these issues, the actual outcome of the positional analysis contradicts the theory. According to the model, the weaker side will always have an incentive to collaborate since it can thereby gain in relative strength. Yet in this case, the Japanese avoided collaboration because doing so would place unwanted constraints on their use of the acquired technologies, an outcome not foreseen in the model.

The final issue is the last item, the Super 301 provision. Unlike the type of agreements the PAR model indicates can promote collaboration through reducing sensitivity to positional issues, the Super 301 directly aggravated such tensions. This provision, contained in the 1988 revision to the Omnibus Export Act, authorized the U.S. to target unfair trading practices of foreign countries for retaliatory measures. In 1990 the U.S. applied this provision to government procurement of satellite launch services,

demanding that they be subjected to competitive bidding and awarded on a cost basis.[123] One effect of this measure was to force Japan to pull a number of satellites from the manifest for future H-2 launches and instead open them up to bids from other launch providers.[124] Far from promoting a sense of shared objectives, this served to highlight the competitive relationship between the two countries.

Table 8. PAR Analysis For the H-2 and LE-7 Engine.

Welfare issues
Promote general bilateral relationship
Positional issues
Prevent competition in commercial launch vehicle market (U.S.)
Prevent launch sales to third parties (U.S.)
Control cyrogenic, stabilization, and guidance technologies (U.S.)
Develop commercially competitive system (Japan)
Demonstrate "catching up" (Japan)
Develop independent technologies (Japan)
Obtain freedom from payload restrictions (Japan)
Sensitivity issues
Super 301 - sensitivity *raising* provision

So for the H-2 / LE-7 engine project, the PAR model appears to have satisfactorily predicted the observed outcome of no collaboration.

International Space Station / Japanese Experiments Module (JEM)

Project Description

The story of Japan's participation in the international space station project begins in 1970. As Johnson Freese relates, it was in that year that the U.S. invited Japan to join

[123]Logsdon, "U.S.-Japan Space Relations," p. 298.
[124]Johnson-Freese, p. 122.

in the "Post-Apollo Program" that was to become the space shuttle program. The Japanese declined the offer, reportedly on the grounds that their capabilities were not sufficiently developed to allow them to make meaningful contributions. Later Japanese space officials came to view this as a missed opportunity to gain invaluable experience in manned spaceflight activities and began to look forward to future opportunities for cooperation. Such an opportunity came in 1982, when NASA invited Japan, Canada, and Europe to participate in early conceptual design work for the space station. Design work began immediately, and formal program approval came in 1989 with the signing of the Memorandum Of Understanding with NASA and its approval by the Japanese Diet.[125]

The Japanese contribution to the project is the Japanese Experiments Module (JEM), a section of the station that will be used for an assortment of laboratory studies. The design includes five major components:

> - Pressurized module: This is the area where Japanese astronauts will work. It is the largest Japanese component weighing 16 tons and measuring 33ft by 14ft and is essentially Japan's first manned spacecraft. It contains 10 internal experiment racks.
>
> - Exposed Facility: This is called the "front porch" and can hold 10 experiments outside the station for tests requiring exposure to space.
>
> - Remote Manipulator System (RMS): The RMS has two manipulator arms, a large one like that on the U.S. space shuttle and a smaller one for more precise positioning tasks.
>
> - Pressurized Logistics Module: This is a 14ft-tall cylinder that holds supplies and attaches to the top of the Pressurized Module. When supplies run low it can be removed for return to earth aboard the shuttle, restocked, and launched again aboard the shuttle or an unmanned resupply ship.

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[125]Johnson-Freese, pp. 141-2.

- Exposed/Experiments Logistics Module: This is an unpressurized supply container, holding equipment for experiments on the Exposed Facility.[126]

The Japanese components are currently scheduled for launch aboard the shuttle on several flights during 2000 and 2001.

As mentioned above, one of the primary motivations for participation in the project from the Japanese government perspective was to gain know-how relevant to manned spaceflight. Despite this objective, the terms of technology transfer in this project were significantly different from those in the time when the U.S.-Japan Space Agreement was still in force. With JEM, NASA applied its normal guidelines that stressed "clean interfaces" and minimal technology transfer between participants. Flows of technology from the U.S. were confined to limited technical assistance and the licensing of off-the-shelf U.S. technology. As John Logsdon notes, this means that

> the Japanese government and the Japanese firms involved in the JEM project are having to invest substantial research and development funds to develop the technological capabilities required to take the early steps toward human space flight.[127]

One of the first steps in addressing these technological hurdles was to form a consortium of Japanese corporations to spread risk and facilitate technology diffusion. The Japan Manned Systems Corporation is a group of 14 aerospace firms and banks led

[126] Craig Covault, "Japan Accelerates Station Development and Promotion," Aviation Week and Space Technology, Vol. 144, No. 5, 29 Jan 96, p. 62.
[127] Logsdon, "Space Relations," p. 299.

by Mitsubishi Heavy Industries that will jointly oversee the JEM project.[128] There are at least two major technology areas the Japanese are concentrating on for the effort:

- Space Debris Protection: Some shielding is necessary to protect the Pressurized Module and its crewmembers from the inevitable collisions with small meteorites. To test different materials and structures, MHI developed a helium gas gun that shoots small particles of aluminum at high velocity to create simulated impacts.

- Software: The artificial intelligence software to control the systems aboard the module is "one of the most important technologies for JEM," according to MHI's program director.[129]

PAR Analysis

As before the first step in the PAR analysis is to compare the relative capabilities of the two participants. In the assessments of the F-2/FS-X and H-2/LE-7, Japan's overall technological capability was rated as nearly equal to that of the U.S. But in this case, the difference is best described as "moderate" since Japan has no experience in manned spaceflight activities.

Starting first with the state level analysis, the issues involved are listed in Table 9. The Japanese government's contribution to the overall station cost is estimated at 310 billion Yen (about $3 billion) or nearly 10% of the station's total cost of $31 billion.[130] The positional transfer is as would be expected according to the PAR model in that it favors Japan, the weaker side. Yet the significance of the positional change for the U.S. is moderated by the comfortable difference in capabilities and the technology transfer

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[128]"Japan Begins $2.5-Billion Effort to Develop Freedom Station Module," Aviation Week & Space Technology, 20 Aug 90, p. 79.
[129]Ibid., p. 82.

restrictions, which ensure Japan pays for the positional gains it realizes. One anomaly comes not from the JEM project itself, but rather from its history. The model predicts the weaker partner will always have an incentive to participate in collaborative projects. Yet in declining to join the original shuttle program due to insufficiently mature capabilities, the Japanese government acted in a way not predicted by the model.

Table 9. State-Level PAR Analysis for JEM

Welfare Payoffs
Increase scientific knowledge through basic and applied research
Decrease project risk by spreading cost
Positional Payoffs
Gain experience in manned spaceflight (Japan)
Sensitivity Reducing Factors
"clean interface" procedures control tech transfer

As shown in Table 10, the factors present in the corporate analysis are quite similar to those for the states.

Table 10. Firm-Level PAR Analysis for JEM

Welfare Payoffs
Increased profits
Positional Payoffs
Gain experience producing equipment for manned spaceflight, especially debris protection, software, and overall systems integration technologies (MHI)
Sensitivity Reducing Factors
"clean interface" procedures control tech transfer

[130] Covault, p. 62; "NASA Space Station 'On Course,'" AP News Service, 11 Dec 95.

Korean Fighter Program (F-16)

Program Description

South Korea's participation in the licensed production of Lockheed F-16 fighter aircraft began in 1991 when both governments signed the authorizing agreements. The country had been in negotiations with McDonnell Douglas for several years before that date, having first expressed interest in the latter company's F/A-18 aircraft. Korea switched to the F-16 after continued cost increases drove the F/A-18's price too high.[131] Known to the U.S. participants as the "Korean Fighter Program" (KFP), the effort involves a total acquisition of 120 aircraft in three phases:

1) purchase of 12 aircraft off-the-shelf from Lockheed in 1994
2) assembly of 36 aircraft from kits provided by Lockheed in 1995-96
3) licensed production of 72 aircraft in Korea from 1997 to 1999[132]

The program has two primary goals: improving the capability of Korea's military aircraft and raising the general technical level of the nation's aerospace industry, thereby enabling it to undertake commercial aircraft development.

The first of these goals -- increased military capability -- is satisfied through the added capabilities the new fighter brings to the South Korean air force. Prior to the KFP, the Koreans operated U.S.-built F-4 and F-5 aircraft. Through a previous program the Koreans had also purchased earlier versions of the F-16 (30 C-models and 10 D-models).[133] The new aircraft covered by the KFP are of the most advanced "Block 52"

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[131]"Lockheed Delivers First New F-16 Produced for Korea," PR Newswire, 2 Dec 94.
[132]Terrence Kiernan, "Seoul Uses Fighter Program to Relax U.S. Yoke," Defense News, 27 Apr 92, p. 22.
[133]Ibid., p. 22.

version, which includes upgrades that increase its capabilities beyond those of the Block 50 in use by the U.S. air force. The specific technology upgrades include:

1) increased performance Pratt & Whitney F100-PW-229 engines
2) Hughes AIM-120 Advanced Medium Range Air-to-Air Missile (AMRAAM)
3) Texas Instruments High-Speed Anti-Radiation Missile (HARM)
4) Airborne Self-Protection Jammer (ASPJ) system
5) Low-Altitude Navigation Targeting Infrared for Night (LANTIRN) system[134]

South Korea will be the only country in the world other than the U.S. to fly Block 50/52 aircraft. And it will be the only country to equip its aircraft with the LANTIRN system, therefore making the KFP F-16's the most advanced in the world.[135]

The KFP is also central to Korea's other goal of increasing the capability of its domestic aerospace industry to the point of being able to produce commercial aircraft. In a general sense, increasing technical capabilities is a way for Korea to remain competitive despite labor costs that have increased 15% a year for the past 10 years: "Stepping up the technology ladder, bureaucrats and businessmen believe, is the only way to compete. A Korean airplane is seen as a way to get there."[136] To that end, the Ministry of Trade, Industry, and Energy (MOTIE) has prepared a 10-year plan for the nation's aerospace industry that targets three sectors: fixed-wing aircraft, rotary-wing aircraft, and satellites. The plan designates aerospace as the most important of all industries for Korea's future

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[134]J.R. Wilson, "Fighting for a First," Jane's Defence Weekly, Vol. 16, No. 23, 7 Dec 91, p. 1120.
[135]"Lockheed Delivers F-16."
[136]"Micheal Schuman, "Korea's Aircraft Industry: Will It Fly?" The Wall Street Journal, 10 Oct 96, p. A17.

and encourages Korean companies to seek technology transfers from U.S. companies.[137] The KFP is the centerpiece of the government's plan for this technology transfer. This role of KFP was assessed by the U.S. F-16 project manager in Korea:

> Looking at aerospace technology in general, there are essentially three areas -- manufacturing, management, and design and development. KFP can provide advances to each of those (for South Korea), but at quite different degrees in each level.[138]

Potential applications for this newly-acquired proficiency in aerospace include development of trainer aircraft and small commercial airliners both for domestic production and marketing abroad.[139]

PAR Analysis

The difference in relative capabilities between the two parties is probably best characterized as "moderate" to "large." This assessment is based on the fact that all of the technology transfer in this project is one-way, from the U.S. to Korea. And yet it is clear that Korea has some minimal level of technical competence, as shown by its indigenous production of a small trainer aircraft and the ability to create production facilities at which to build the F-16's. If Korea did not have at least this level of ability it would have had no choice but to purchase off-the-shelf systems. It is interesting that this project begins with such purchases and then develops into local production, after the transitional phase of assembling kits. Such a sequence indicates Korean aerospace

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[137]"Korea -- Aerospace Development Plan," U.S. Department of Commerce Market Research Report, 27 Sep 95.
[138]Wilson, p. 1120.
[139]Commerce Report.

capabilities are judged by both parties to be minimally qualified for the undertaking but still in need of confidence-building steps at the outset.

As for the assessment of interests, both Korean industry and government have motivations to participate in the project, as is predicted by the PAR model. For the stronger U.S. side, corporate and state interests are identical to those discussed for the F-2/FS-X with the exception of the technology flowback provision. The technology in question is the same, the F-16. While it is true that the Korean aircraft will have advanced electronics and weapons systems, these components are not part of the licensed production deal; Samsung's work is on the airframe itself.

A difference from the F-2/FS-X case is that the Koreans are much more open about their objective of translating know-how gained through military projects into civilian aerospace applications. While this was a major issue in the Japanese case because of the widespread belief that they had the capability to become a threat to U.S. aircraft manufacturers, in the Korean case the greater disparity in capabilities likely reduced such concerns. Even if such a transfer were possible, the fact that the Korean aerospace industry is currently just beginning its first rudimentary projects means any real competition remains a concern for the relatively distant future.

State and corporate interests are shown in the following tables.

Table 11. State-Level PAR Analysis for KFP.

Welfare Payoffs
Improved defensive capabilities against threats
Positional Payoffs
Increase capability of aerospace industry (Korea)
Sensitivity Reducing Factors
U.S.-Korean alliance

Table 12. Firm-Level PAR Analysis for KFP.

Welfare Payoffs
Increased revenues
Positional Payoffs
Aircraft production experience (Samsung)

Assessment of the PAR Model

From the four case studies presented above it is now possible to assess the degree to which the PAR model has proven useful for analyzing real-world collaborative projects. Table 13 on the following page summarizes the results of the case studies. In all, they appear to provide a considerable degree of validation for the PAR model. The latter two cases fit the model quite well: Collaboration occurred with moderate differences in capabilities, a net positional advantage to the weaker party, and sensitivity-reducing factors (and welfare payoffs) that made the deal acceptable to the stronger party. The first two cases also provided limited validation for the model, as small capability

Table 13. Summary of Case Studies.

Project	Stronger Party	Capability Difference	Positional Winner	Sensitivity Factors	Outcome
F-2/FS-X	U.S.	small	ambiguous	alliance tech flowback workshare	collaborated
H-2/LE-7	U.S.	small	U.S.	Super 301	no collaboration
Space Station JEM	U.S.	moderate	Japan	minimum tech transfer	collaborated
Korean Fighter Program	U.S.	moderate to large	Korea	alliance	collaborated

differences led to greater instability. Sensitivity factors were critical for these cases, as the significant sensitivity-reducing measures in the F-2/FS-X allowed the project to succeed while the aggravating factors in the H-2 case made collaboration even less likely. These case studies support the following conclusions about the model:

- **The model was useful for describing the interests and motivations of parties in both successful and unsuccessful cases.**

- **The key factors cited in the model (capabilities, interests, payoffs, and sensitivity issues) served to satisfactorily explain most behaviors.**

Several anomalies, though, appear in the first two cases. In essence it appears that these relate to the assumption that collaboration will always benefit the weaker party. In the H-2 case, the Japanese elected to pursue an independent approach because of unacceptable constraints that would have accompanied collaboration, leading to a net

benefit to the U.S. rather than to Japan. Likewise in the F-2/FS-X case, the positional outcome was ambiguous as some analysts determined the U.S. realized greater benefit from the cash flow while others assessed greater benefit to the Japanese from the technology transfers.

This ambiguity cited in the latter case relates to another observed shortcoming of the model, which is the difficulty of precisely determining both capabilities and payoffs in any given situation. While it was possible to make meaningful qualitative assessments based on technology studies and the judgments of experts, the imprecision of these studies left much to be desired. In fact it was the disagreement regarding various "expert assessments" of the positional payoffs that led to such controversy for the F-2/FS-X. The final result appears to be that determinations of capabilities and payoffs are, in the end, matters more of perception than of arithmetic. The key variables are not absolute values but rather the perceived values held by the potential participants.

The notion of perceived values introduces the final complicating factor, which is the fact that there may be considerable disagreement among domestic groups in a single state as to the true nature of national interest. While at any time one group will tend to dominate the foreign policy-making apparatus and thereby have considerable influence in setting the declared policies, the other factions may still have sufficient influence to create de facto interests that cannot be ignored.

Therefore, as a result of these observations, the following caveats will be added to the PAR model:

- There may be cases in which collaboration does not provide a net positional advantage to the weaker party. These include cases in which there would be excessive constraints on the use of acquired technologies or excessively large payments to the stronger party.

- The determination of capabilities and payoffs ultimately rests on the *perceptions* of the parties involved rather than objectively quantifiable factors.

- The determination of payoffs can be further complicated by the presence of dissent among domestic factions regarding the nature of the national interest and its calculation.

These results will be incorporated into a modified form of the PAR model for use in discussion of the Theater Missile Defense Program in the next section.

Part IV: Implications for Theater Missile Defense

This section will apply the information gained in the preceding sections to assess a proposed collaborative aerospace project, the Theater Missile Defense (TMD) program. The discussion will follow the format established for the previous case studies, with a brief description of the project followed by an analysis using the PAR model. In this case, however, a modified PAR model will be used that incorporates the changes identified through the case studies. The goal of the discussion will be to predict the likely outcome of the proposal by identifying those areas that will be conducive to collaboration and those that will tend to hinder it.

Project Description

The basic concept behind TMD is that the U.S. and Japan would jointly deploy and possibly jointly develop a system to protect Japan (and thus U.S. forces stationed there) from ballistic missiles fired by opponents within Asia. The background for the current TMD proposal began in 1971, when Secretary of Defense Melvin R. Laird proposed to the Japanese that they deploy an "area ballistic missile defense" system.[140] That proposal envisioned a fleet of 40 ships armed with Spartan nuclear antimissile missiles with fire control provided by a Nike-X radar system. This proposal failed to attract significant Japanese interest for two reasons: the sizable $2 billion price tag and the fact that the defensive weapons were themselves nuclear. This latter factor created excessive complications by entangling the issue with domestic Japanese disputes over the

[140]Harrison, Japan's Nuclear Future, p. 16.

possession of nuclear weapons. According to Harrison, the only faction within Japan that wanted to develop such weapons based their position on a desire for greater independence from the U.S., an outcome that would not be furthered through a joint project of this type.[141] Therefore the Laird proposal was eventually dropped.

Cooperation on missile defense was proposed again in 1987. In that year the U.S. Strategic Defense Initiative Organization (SDIO) signed a Memorandum of Understanding with JDA, MITI, and MOFA for joint research into SDI-related technologies.[142] The SDIO also funded a study entitled "WestPac" (Western Pacific Basin Architecture Study) conducted by U.S. and Japanese industries which examined the ballistic missile threat and Japan's capabilities for defense. The WestPac study concluded that then-deployed Patriot antitactical missiles would be unable to counter larger, theater-range ballistic missile attacks from North Korea or China.[143]

Therefore in 1993, U.S. Secretary of Defense Les Aspin made a formal proposal that Japan join in a new TMD program and laid out four options:

> **Option A:** A $4.47 billion package deployable in 2004. Primary elements of the system would include four AWACS aircraft, two *Aegis* radar-equipped destroyers, the Block IVA version of the Navy's Standard Missile, and upgrades to Japan's existing 24 Patriot batteries to the PAC-3 level. This option would protect against North Korean missiles but not the larger Chinese ones.

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[141]Ibid., p. 17.

[142]Steven A. Hildreth and Gary J. Pagliano, "Theater Missile Defense and Technology Cooperation: Implications for the U.S.-Japan Relationship," Congressional Research Service, 21 Aug 95, p. 5.

[143]Ibid., pp. 5-6. Japan has 24 U.S.-made Patriot Advanced Capability (PAC-2) missile batteries and has a coproduction agreement with Raytheon, the U.S. manufacturer, to build their own which should be operational in FY 1999.

> **Option B:** A $16.3 billion package deployable in 2005. Primary elements include those for Option A plus six more *Aegis* destroyers and a ground-based radar system to be built near Tokyo. This package would protect against both North Korean and Chinese missiles.
>
> **Option C:** A $8.78 billion package deployable in 2005. Primary elements include four AWACS planes, 24 PAC-3 batteries, the ground-based radar near Tokyo, and six batteries of the Theater High Altitude Area Defense (THAAD) missiles currently under development by the U.S. Army. This combination also protects against both North Korean and Chinese missiles.
>
> **Option D:** A $8.9 billion package deployable in 2005. This option would be the same as Option C except that 2 *Aegis* ships would be substituted for the AWACS aircraft. Both North Korean and Chinese missiles could be destroyed by this system.[144]

Other technologies are also under consideration, including an airborne laser system carried by a 747-type aircraft.[145] Each of these systems has different proponents among the U.S. military services (with the Army favoring THAAD, the Navy favoring *Aegis*-based systems, and the Air Force the airborne laser) and each faces some degree of uncertainty regarding technical feasibility.

This fluidity in the architecture means there is room for Japan to play a role both through technical R&D and establishing overall requirements, if they choose to do so. According to some U.S. industry observers, Japan has little off-the-shelf technology to contribute to the TMD program.[146] But over an extended R&D program, U.S. and Japanese industry representatives determined Japan could contribute in the following areas:

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[144]Ibid., p. 7 and "JDA Seeks Missile Defense Funds," Periscope Daily Defense News Capsules, 21 Aug 95.

[145]"Circles of Fear," The Economist, 4 Jan 97, p. 33.

- composite materials
- advanced radars and sensors
- semiconductors
- liquid crystal displays[147]

Initially the Japanese response to the offer was less than enthusiastic. There were several reasons for this, the first of which was related to the manner in which Aspin presented the offer. Prior to making the TMD invitation, the U.S. had introduced the "Technology for Technology" (TfT) initiative. The goal of TfT was to increase the flow of Japanese technologies to the U.S. by seeking access to Japanese commercial technologies in exchange for U.S. defense technologies. This proposal ran into several objections from Japanese firms, since the companies that had the technologies most desired by the U.S. were also the companies least involved in defense-related work in Japan.[148] When Aspin first presented the TMD option to his Japanese counterpart, JDA Director General Keisuke Nakanishi, he "linked" TMD to TfT by saying Japan would be required to share commercial technologies in exchange for the privilege of participating.[149] When the JDA did not respond favorably to this approach, DoD changed tactics and separated the TfT and TMD issues, offering Japan the options above which included purchase of off-the-shelf U.S. equipment or codevelopment of advanced systems.[150] Soon thereafter JDA officials stated that developing a missile defense system

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[146]Hildreth and Pagliano, p. 11.
[147]Ibid., p. 11 and "U.S. and Japanese Defense Industries Agree on Cooperative Forum," Armed Forces Newswire Service, 15 Aug 96.
[148]Green, Arming Japan, p. 141.
[149]"Japan, U.S. Fail to Agree on Missile-Defense Group," Japan Economic Newswire, 28 Sep 93.
[150]NRC, Maximizing U.S. Interests, p. 53.

was the "top task" for the agency although the degree of cooperation with the U.S. was still unresolved.[151] This "de-linking" of TMD from TfT helped overcome the first obstacle in the path to possible collaboration.

Yet other issues remained. One of these was concern that any TMD system might violate the 1972 Anti-Ballistic Missile Treaty. Although technically the ABM treaty was between the U.S. and the Soviet Union and therefore Japan would be free to develop any system without violating the treaty, the fact that significant U.S. technology assistance would be required made this argument questionable. The heart of the issue was the capability of the system to intercept ICBMs. These missiles are larger and travel at greater velocities and for greater distances than theater ballistic missiles, meaning that interceptors capable of destroying them require greater capabilities than TMD systems. But the dividing line between "intercontinental" and "theater" weapons was not clearly established. This issue was finally resolved in March of 1997 when President Clinton met with Boris Yeltsin at Helsinki and the two leaders agreed that TMD systems would not violate the ABM treaty as long as they were not tested against missiles traveling faster than 5 km/s or further than 3500 km.[152] These parameters cleared all current U.S. TMD systems under development from these treaty concerns.

So two significant hurdles have been overcome. Nonetheless, there are several that are still unresolved. The following list is consolidated from several analyses of the TMD proposal:

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[151] "Defense Agency Plans to Develop Sophisticated Antimissile System," Report From Japan (A Yomiuri News Service), 31 Dec 93.

1) There is concern that a TMD system would constitute a military use of space, which by policy Japan has declared it will not do. There are two subcomponents of this issue -- the use of space for intelligence collection and the actual interception of incoming missiles in space.

2) There is concern that creation of a TMD system would obligate Japan to perform a collective security role. This could occur either if South Korea were attacked and the U.S. called on Japan to come to its neighbor's aid or if Japan were pressured to share TMD technology with Korea if that country began to construct its own system (with the U.S.).

3) Japanese defense budget constraints will make significant contributions difficult.

4) Current U.S. security guarantees are seen by many as sufficient for the Japan's needs, at least in the near term.

5) Some doubt the technology under development is sufficient to provide a meaningful defense.

6) There is some concern that such a system could disturb the greater regional security equilibrium. China in particular has stated that it considers TMD to be threatening. Other observers raise concerns that defensive systems can be inherently destabilizing if opponents have an option to counter them by increasing the number or capability of their offensive weapons.[153]

The final concern, while significant, lies outside the scope of the PAR framework since it concerns multilateral issues. Therefore it will not be analyzed further herein.[154] The fifth

[152]"Another ABM Giveaway?" The Wall Street Journal, 24 Mar 97, p. A18.

[153]listing consolidated from: Naoaki Usui, "Japan to Get U.S. Spy Data; Sees Move as Push for Joint Missile Defense Program," Defense News, 16 Jun 96, p. 4; Hildreth and Pagliano, pp. 20-21; and Janne E. Nolan, "The Politics of Proliferation," Issues in Science and Technology, Vol. VIII, No. 1, Fall 1991, p. 66.

[154]It would be possible to work this issue into the PAR structure by ascribing to the U.S. and Japan a mutual welfare interest in maintaining regional stability through avoiding destabilizing weapons systems and those likely to provoke strong opposition from China. But this approach would still suffer from the drawback that it would require extensive analysis of Chinese-side factors before a characterization of "stabilizing" or "destabilizing" could be assigned with any degree of certainty. Giving this issue its due

point will also be set aside since it deals with the limitations of technology, not motivations for collaboration; technical risk is a factor whether the project is pursued independently or jointly. That leaves the first four issues, all of which are essentially matters of Japanese domestic politics and defense policy. Faced with these concerns, the Japanese to date have not committed to TMD. JDA has funded analytical studies and conducted meetings with U.S. counterparts, allocating 440 million yen for research costs in fiscal years 1996 and 1997.[155] But there has been no significant movement towards collaboration. The next section will attempt to use the PAR model to determine the reasons for this and the project's prospects for the future.

PAR Analysis[156]

The question then, is whether the PAR model can provide any additional insight into the prospects for collaboration on TMD. The first point to address is the applicability of the PAR model to this project. The model is designed to deal with mixed-motive situations, in which the parties have both welfare and positional concerns. Yet nothing in the preceding project description explicitly states there are positional

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consideration really requires at least a trilateral (U.S., Japan, and China) and possibly even quadrilateral (with Korea) analysis. This shortcoming of the PAR model is not presented as a major finding since Tucker clearly acknowledges it in his own presentation.

[155] "Japan, U.S. Discuss Missile Defense System," Kyodo News International, 28 Oct 96.

[156] This analysis will be confined to a discussion of state-level interests. This is because the project has not progressed to the point of involving significant corporate interests that could be analyzed in any meaningful way. Until the basic architecture of the project is decided on by the respective governments the specific firms and technologies involved will not be known.

concerns; the unresolved issues all deal with Japanese domestic politics and policy, not concerns of one party about competition with the other.

In reality, though, positional interests are important in TMD. They are merely obscured because they have been incorporated into the terms of the U.S. offer. The U.S. has, in a sense, really given Japan two options for participation in the project: purchase off-the-shelf U.S. systems or codevelop an advanced one. In the first, the U.S. receives large payments for its technologies while in the second it receives flowback technologies. These are the conditions the U.S. is imposing to protect its positional interests and ensure the project does not devolve into another case of one-way technology transfer from the U.S.[157] In the terminology of the PAR theory, these conditions are the sensitivity-reducing measures that the U.S. is insisting on. The question, now, is whether Japan will be willing to accept these terms.

The original PAR theory stated that the weaker party always had an incentive to collaborate since net positional gains would inevitably work to its advantage. Yet as was determined through the case studies in Part III, this is not always true. To reiterate the finding,

> **There may be cases in which collaboration does not provide a net positional advantage to the weaker party. These include cases in which there would be excessive constraints on the use of acquired technologies or excessively large payments to the stronger party.**

[157]These two options are derived from longer lists of conditions that appear in "Better Framework Needed for Allied TMD Work, Policy Group Says," Aerospace Daily, 20 Feb 97, and Hildreth and Pagliano, p. 18.

In the case of TMD, the excessively large payments may be financial, technological, or political as detailed in the concerns listed above.

There is no question that in this case, Japan is the weaker party. The previously-stated fact that the country has no off-the-shelf technologies to contribute confirms this. Yet Japan does have some TMD-relevant capabilities. In addition to the four general technologies cited by the U.S. (composites, radars and sensors, liquid crystal displays, and semiconductors) Japan has an indigenous program known as "Future SAM" underway to develop a medium-range surface-to-air missile for air defense purposes.[158] This program should give Japan specific capabilities in defensive missile development that would enable the country to make meaningful contributions to a TMD project. Therefore the overall capability difference between the countries is probably "moderate."

As predicted by the PAR theory and observed in the case studies, collaboration under conditions of moderate capability difference is the easiest to achieve. While sensitivity-reducing measures may be used, they need not be as strong as for cases of "small" capability difference. This point is important because the U.S. side is basing its approach to TMD on the F-2/FS-X experience, which was one in which the relative capabilities were much more evenly matched. It is possible, therefore, that the U.S. conditions are overly-stringent in this instance. One sign that this might be the case is the recent offer by the Pentagon to provide Japan satellite intelligence information. According to press reports, the JDA interpreted the offer of data from Defense Support Program (DSP) satellites which detect infrared signatures of missile launches as a move

to encourage Japanese participation in TMD.[159] This would appear to be an attempt to increase Japan's positional payoff from collaboration so that it will accept the reciprocity conditions demanded by the U.S.

It is now possible to summarize the payoffs at stake in the TMD proposal in the following table.

Table 14. PAR Analysis for TMD.

<u>Welfare Payoffs</u>
Protect against theater missile threats
Expand scope and strength of bilateral alliance
Increase technical capabilities
Reduced cost and risk over independent projects
<u>Positional Payoffs</u>
Access to composite, radar, LCD, and semiconductor technologies (U.S.)
Access to satellite intelligence data (Japan)
Access to advanced guidance and TMD technology (Japan)
<u>Sensitivity Factors</u>
Requirement for technology flowback, or
Requirement for reimbursement of R&D costs
Bilateral alliance

Two important conclusions come from this analysis. The first is that a key control variable for the U.S. may be the degree of stringency in its demands for sensitivity-reducing measures. Varying this factor could have an impact on the willingness of the pro-TMD groups in the Japanese government to bear the domestic costs associated with the remaining political and policy obstacles.

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[158]NRC, <u>Maximizing U.S. Interests</u>, p. 113.
[159]"Japan to Get U.S. Spy Data."

The second conclusion derives from the fact that the appropriate degree of sensitivity-reducing measures is itself driven by relative capabilities. It is important here to recall the second modification to the original PAR theory that came out of the case studies:

> **The determination of capabilities and payoffs ultimately rests on the *perceptions* of the parties involved rather than objectively quantifiable factors.**

The significance of this is that if the executive branch of the U.S. government determines it is in the national interest to lower the level of required payback or flowback, this may require some means of convincing the other domestic constituencies (i.e., Congress and industry) that the relative capability difference really is "moderate" and not "small" as some may perceive it to be, particularly those with clear memories of the F-2/FS-X. The same holds true for the Japanese side, as supporters of the program face the task of convincing others that there is some proportionality between the two countries' relative capability levels and the U.S. side's reciprocity requirements.

So ultimately the PAR model cannot predict that the TMD proposal will succeed nor can it predict that it will fail. But it does appear to be useful as an analytical tool for laying out the issues involved and identifying factors that will contribute to collaboration and others that will hinder it.

Conclusion

International collaboration in aerospace is becoming an increasingly common phenomenon. The reasons for this increase stem primarily from a desire among those involved in such projects to reduce risks, particularly since the costs of these endeavors continues to increase while budgets and certainty of returns are decreasing. Yet the trend toward collaboration is complicated by the fact that the sharing of technology in a joint undertaking can have the undesired effect of enabling today's partner to become tomorrow's competitor. Thus the study of these collaborative projects requires a theoretical approach which accounts for this mixture of motives. One such model is Jonathan Tucker's "Partners and Rivals" (PAR) theory, which provides a technique to analyze each party's net interest, given as inputs the relative capabilities of each side, an understanding of their interests, and the presence of any other mitigating factors.

This study examined the national interests of the U.S., Japan, and South Korea relevant to both military and civil aerospace projects. It then introduced four case studies, three of which were collaborative and one that was pursued independently. Each of the cases was analyzed using the PAR model and compared to the theoretical predictions. Based on the results three new caveats to the PAR model were derived:

> **There may be cases in which collaboration does not provide a net positional advantage to the weaker party. These include cases in which there would be excessive constraints on the use of acquired technologies or excessively large payments to the stronger party.**
>
> **The determination of capabilities and payoffs ultimately rests on the *perceptions* of the parties involved rather than objectively quantifiable factors.**

The determination of payoffs can be further complicated by the presence of dissent among domestic factions regarding the nature of the national interest and its calculation.

Finally this modified PAR model was used to evaluate the proposed Theater Missile Defense program. While the theory was unable to predict whether the project would succeed or fail, it did provide a mechanism for gaining insight into the nature of the obstacles currently hindering collaboration as well as some possible approaches to resolving these issues. The key conclusions were:

1) A primary area of disagreement is among domestic groups within Japan and involves varied determinations of national interest.

2) The willingness of pro-TMD groups in Japan to engage their opponents in this disagreement may in part be related to U.S. demands for technology flowback and monetary compensation for R&D costs.

3) The U.S. reciprocity demands are driven partially by perceptions among domestic U.S. groups regarding the balance of capabilites between the two countries.

4) Therefore the executive branch agencies in the U.S. might be able to influence the project's prospects for success by varying the strength of the reciprocity demands and attempting to modify domestic perceptions of the capability balance.

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5 Jun 97

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